J. Nelson Spaeth.

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EDITORIAL

Imminent Problems in Forestry Education

SEVERAL years ago Lord Haldane expressed the opinion that, "it is in universities that the soul of a people mirrors itself." If this be true for society as a whole, it should be equally true that the soul of professional forestry is reflected in the forestry schools. Consequently, the intellectual well-being of the forestry schools is a matter of deep concern not only to forestry educators and students, but to all foresters, however employed.

The facilities and financial support of many American forestry schools have improved greatly in the past five years. The foundation for this improvement, due largely to the great increase in enrollments and to the efforts of Professor H. H. Chapman in focussing the attention of university administrators on the deplorable educational facilities in many forestry schools, was laid some years before by the Forest Education Inquiry made under the direction of Dean Henry S. Graves. The contributions of Professor Chapman and Dean Graves must be regarded as the most significant yet made to forestry education in the United States.

Although this improvement in educational facilities of American forestry schools may be gratifying to all those interested in forestry education, in the face of probable future trends it is disquieting that these improvements have not been more largely the result of the educational statesmanship and the scholarly activities of the forestry faculties rather than the result of student pressure and outside support.

A decline in forestry registration appears to be inevitable. Under most favorable circumstances, this decline might be regarded as an unmitigated blessing because it will give faculty members some relief from excessively heavy teaching and administrative duties and will thus afford an opportunity to arrest the intellectual deterioration inevitably resulting therefrom. If, however, the increased financial support now enjoyed by many forestry schools has been largely the result of inordinately large registrations, what will happen when these registrations materially decline? Will this increased support be withdrawn? This probably will be the case *unless* members of the forestry school staffs are ready and qualified to take advantage of the opportunities the situation clearly affords. These opportunities lie in two directions: (1) the improvement and strengthening of the existing educational program; and (2) greater activity in research.

Forestry education could be improved and strengthened in at least three ways: first and foremost, the educational background and intellectual qualifications of many members of the forestry school faculties could be raised; secondly, the program of study for professional forestry could be increased from four to at least five years; thirdly, forest curricula could be overhauled to eliminate the dross and to increase the content of fundamental subjects.

Although the subject of the qualifications of forestry school faculties is a delicate one, nevertheless, any proposals that do not consider this subject are of necessity unrealistic and superficial. The greatest single need in forestry education, as in all other fields of education is more competent scholars. Competent scholars cannot, however, be picked from thin air. In a very real and fundamental sense, they are the fruits of an effective educational program. A weak educa-

tional program does not produce many competent scholars, and until these are available the educational program cannot be greatly strengthened. This does not mean, however, that forestry education is stymied. It does mean that a persistent and conscientious effort must be made, first to select for teaching positions the most promising men available, and then to create environments which will permit their further growth and development. Some degree of economic security, some leisure time for study and research, and some time for travel are essential; but more important still is it that the intellectual atmosphere of the forestry schools be such that genuine scholarship will be encouraged if not actually demanded.

To argue the point that the program of study for professional foresters be increased from four to at least five years hardly seems necessary. Many of the older and all of the more highly developed professions now require a five-, six-, or even seven-year period of education and training. For many years at least one American forestry school has been on a five-year basis; others are now following and sooner or later all forestry schools will likely make the change.

For several years forestry schools have been toying with the idea of establishing minimum requirements for professional training. Very soon, however, they will have to come to grips with this important problem. One solution, perhaps the best, lies in the five-year curriculum. Never has the time for making such a change been more propitious. Schools that do not take advantage of these conditions thus to strengthen their educational program may miss a golden opportunity.

The third way in which the educational program could be improved is by a general overhauling of professional forestry curricula. Many of these curricula contain material more or less of subcollege grade, either because of the nature of the subject matter, or the manner in which it is presented. More attention should be given to courses designed to educate rather than to train students. There has been too much training and too little education. Except in rare instances, purely descriptive courses have no legitimate place in college curricula. On the other hand, there is no good reason why most forestry courses cannot be taught on a college level.

If enrollments decrease and they undoubtedly will, teaching loads will undoubtedly decrease, provided, of course, staffs are not reduced proportionately. If the staffs are decreased as enrollment decreases, then teaching loads will remain unchanged. If, however, forestry educators convince their administrative officers that there is ample work for a larger staff, despite shrinking enrollments, then it will be possible to make significant progress in raising the general level of forestry education. Furthermore, a reduction of the teaching load will give faculty members increased opportunity for carrying on more and better research.

A recent survey of forest research in the United States shows no dearth of *research projects.* In all, work is being done on over 1,300 projects, 250 of which are supported by the forestry schools. This survey also shows that during the past fiscal year approximately 7 million dollars was spent on forest research, about 165 thousand dollars of which was expended by the forestry schools. Even though these figures may be only estimates, obviously considerable money is being spent on forest research. Of this, the forestry schools are expending only a comparatively small part.

Research activity in some American forestry schools is practically nil. Every forestry school must carry on a research program, limited though this may be, as well as a program of instruction, if it wishes to be considered a worthy department of a university worthy of the name. Actually, there is no escape from this responsibility. It does not follow, however, that every member of staff of every forestry school faculty should engage in research. Some clearly should not. There is, to be sure, a place for teachers as such in a university. Nevertheless, no department in a true university can long command respect inside and outside the university if at least some members of staff do not make a reasonable contribution to the advancement of knowledge.

After some years of smooth sailing forestry schools appear to be headed for a little stormy weather. This may be a blessing in disguise: it may result in a general overhauling of the educational rigging; it may give an opportunity for determining the efficiency and scholarly attainments of the staff members; it may indeed test the very soundness of the entire program of forestry education. If this storm is long-lasting and unusually severe, a few forestry schools may be lost, but those that survive will be better able and better qualified to carry on the work they have set out to do because of the experience they have gained under adverse conditions. To these survivors must the profession look to carry the program of forestry education forward.

JOSEPH TRIMBLE ROTHROCK: THE FATHER OF FORESTRY IN PENNSYLVANIA

By GEORGE H. WIRT

Pennsylvania Department of Forests and Waters

Dr. Joseph Trimble Rothrock was born in Pennsylvania April 9, 1839. His interest in forestry antedated by many years the advent of the first technically trained American forester. One of that group of pioneers whose early efforts in behalf of conservation have left lasting imprints on the country's attitude towards its renewable natural resources, Dr. Rothrock was actually and literally "the father of forestry in Pennsylvania." This estimate of his character and accomplishments was written by one who knew him well and who was associated with him intimately and professionally for more than twenty years. Mr. Wirt was the first technically trained forester employed by the Commonwealth of Pennsylvania. His article commemorates the one-hundredth anniversary of Dr. Rothrock's birth.

ANY open-eyed person who observes what he sees as he travels through Pennsylvania can barely escape the name of Joseph Trimble Rothrock.

In a woodland park near West Chester there is a modest marker indicating the place where his body was interred. In the assembly hall of the West Chester High School there is a bronze plaque carrying a beautifully designed profile medallion and a eulogy of him as a patriot, physician, citizen, friend. At Mont Alto there is a bronze plate at the entrance to the forestry school designating him the founder of the State Forest Academy. On a boulder at the Mont Alto Sanitorium there is a bronze plate proclaiming him the founder of the first state sanitorium for the treatment of tuberculosis. At Harrisburg, as one approaches from the west the Education Building, in the state group, one observes his name carved large in the frieze and placed with the names of famous scientists of the Commonwealth. Near the rotunda of the main capitol building is a marble slab with bronze medallion naming him as "Father of Forestry in Pennsylvania" and reciting a long list of his achievements. At McVeytown, his birthplace, a rough mountain boulder bears a bronze plate showing him as a pioneer looking out over wide reaches of forests.

Loving cups were engraved and presented to him. Trees and groves have been planted and named in his honor and memory. College and university catalogues carry his name both as student and professor. State and national archives contain his records and reports. The proceedings of the American Philosophical Society, medical journals, botanical journals, forestry magazines, and many other publications carry his writings. Others have written his name in big letters across the face of Pennsylvania, because he wrote his name deeply in the hearts of his fellowmen.

Dr. J. T. Rothrock was a man of varied activities and experiences and made enviable records in many of them. He was soldier, master mariner, explorer, botanist, physician, surgeon, author, lecturer, university professor, pioneer in forestry agitation and development in the United States and especially in Pennsylvania. The one term that might cover all others and still be most descriptive of his work would be "public servant."

Having been associated very closely with him for over twenty years, I had ample opportunity to observe his self-sacrificing service which was constantly but not obtrusively in evidence. Aside from other factors which went into the making of a strong character, such as a Christian father and mother, a devoted wife and family, the hardship of army and wilderness camp, the refinements of college, university, and polite society, it has always appeared to me that perhaps the effects of two special incidents in his life might have been determining factors.

While still a boy in his home town, he and a companion were in the "old swimmin' hole" and for some reason both got beyond their depth. Fortunately another young man nearby noticed them but only in time to save Joe from drowning. On the slope of the hill facing the river in the McVeytown cemetery is a modest tombstone marking the burial site of that man, J. Lockard Brown, who was too poor to have a tombstone except at the expense of someone else. But Joe Rothrock's life was saved as by a miracle.

After the battle of Fredericksburg, where he had been seriously wounded, young Rothrock was in the hospital as a hopeless case. One day Abraham Lincoln came through the ward and

shook hands with each one. As he passed Rothrock's cot, he lifted the boy's hand and said to him, "God bless you young man, the country needs men like you." In a comparatively short time that seriously wounded soldier was back home organizing a troop of cavalry of which he became captain.

One day in answer to a question of mine he stated that he had received many flattering offers to go to other states in various capacities, but he felt that Pennsylvania had given him everything he had that was worth-while and in return he would give everything he had to Pennsylvania.

Fired by a belief that his life was given back to him twice and by a sense of obligation to the Commonwealth, Dr. J. T. Rothrock lived and served with little thought for himself.

It would be interesting to follow the chain of circumstances which ran through a maze of experiences and finally resulted in Rothrock's devoting himself to awakening the people of Pennsylvania to the necessity of caring for their forests. A few links might be mentioned. His father was a physician. As a boy he came to know the local forest areas. As a student, Asa Gray guided him into the study of botany. It is impossible to know whether it was the prospective physician working on plants, or the prospective botanist working in medicine, but certainly there was a close tie-up. Although he never gave up his study of medicine, nevertheless, the fact remains that he gave up a lucrative medical practice to devote his time to botany. It was while he was studying botany in Germany that he learned the fundamentals and possibilities of forest management. It was as a young physician that he advocated and proved the value of Pennsylvania forests as a factor in the restoration of health for its citizens. It was as a botanist that he traveled from Alaska to the tropics, from Maine to the Caribbean Sea, and knew the forest resources of this continent as few, if any, other man knew them. He knew the forests of Pennsylvania from Philadelphia to Erie and from Pittsburgh to Milford. He saw the primeval forests gradually fading out of the state. He knew that the continued development of the growing cities was dependent upon adequate supplies of pure water. In spite of rich mines of coal, he had visions of the ultimate development of water power. He had seen alternate drought and flood in the treeless regions. He believed in Pennsylvania and had fought for the idea of the state's obligation to provide its own future welfare.

He was head of the Botanical Department in the School of Medicine at the University of Pennsylvania in 1877 when the American Philosophical Society wanted someone to become Michaux lecturer on forestry; he was chosen. He was the logical choice of the Pennsylvania Forestry Association in 1886 when a secretary was wanted to lead them and the people of Pennsylvania in a program for a sensible attitude with respect to the rapidly vanishing forest resource. This led to the State Forest Commission, and then Commissioner, and finally in 1901 to the head of a Department of Forestry in the state government.

It should be remembered very definitely by the foresters of today that Dr. Rothrock, unlike many of his contemporaries, never considered himself a forester and disliked being called one. But he studied more forestry and checked his deductions with more European foresters of prominence than any forester that I know in the United States today. As a botanist and surgeon he knew the sciences upon which the growth of trees and the management of forests depend. As a soldier, sailor, and explorer, he knew the practical side of life, and fine-spun theories which were impractical were quickly detected by him. As a patriotic citizen he was interested in the welfare of his state and knew only too well the political and economic difficulties of his time.

Dr. Rothrock's philosophy with respect to forests and their place in the economics of Pennsylvania was comparatively simple and he never tried to make it appear complicated. The primeval forests were a tremendous reservoir of tree crops from which the people of the state were mining great wealth and establishing a most glorious commonwealth. Unfortunately, however, the people were blind to the "areas of desolation" which were developing after the lumber operations. These areas would not support a continuing industry. He saw lumbering, tanning, wood working, and other industries fade away. He saw ghost towns with men, women, and children stranded without a livelihood and no hope in life except to pull up stakes, move out, and start over again. He saw desolation not only in the forest region but also in the hearts and lives of people. He remembered when pioneer women could not dry their clothes in the forest clearings and later saw prolonged droughts

and high floods all over the state. He had seen mountains and sand dunes reclaimed by forests abroad and knew it could be done here if the people could be aroused to their own situation.

He did not seem to be bothered about a timber famine in Pennsylvania, but he was disturbed because of the economic burdens which would be borne in future years as a result of needless waste and deadly indifference. He had no fault to find with the lumberman, but he did condemn the carelessness and indifference to forest fires. He saw the robbing of soil on farms and advocated the planting of trees to hold the soil and its fertility, to protect the banks of streams, and to help the water supply for crops.

He stated always that forest management would be practiced by individuals or by governmental bodies only when such management would pay for itself, and he recognized the difference between the returns desired by persons and by society. He advocated the policy of state forest reserves, not because he believed in governmental ownership of natural resources or of government going into business, but rather because he believed that the only way our American people would learn forestry and what it could do was for the state to show them. There was one exception to this idea in his philosophy. He believed that hunting and the use of fire arms learned in hunting made a direct contribution to national defense. He had seen game disappear with the forest and in fire. He saw large tracts of wildland posted against hunting and fishing. He considered the maintenance of hunting and fishing opportunities as a state health insurance policy. He wanted state forests to guarantee to the poor of the state a perpetual hunting and fishing ground and an area to which they might go at all times for such recreation as can be found naturally associated with forest conditions.

Through his years of experience he knew only too well how impractical many enthusiastic supporters of a new program could be. He realized the need of men trained as foresters. Politics constantly stared him in the face. As soon as he would talk about jobs the politicians were on the jump. He finally convinced the Republican leaders of Pennsylvania that politics did not determine a man's knowledge of forests or economics, and that if they wanted to have the credit for beginning and developing a new policy which was being endorsed generally over the country they would have to let him have trained men and to let him build a group of loyal state servants from young men chosen for the job rather than because their fathers had voted this way or that. Be it said to the everlasting credit of Dr. Rothrock and the Pennsylvania Republican leaders that that policy was adopted and adhered to for a period of twenty-five years during which time forestry became an outstanding project for the welfare of the state and nation. He said time after time that as soon as salaries were raised to the standard of other technical jobs the politicians would break away from their original policy and make forestry and state forests a political football.

Dr. Rothrock had an abiding faith in people both as individuals and as groups. He believed in educating the whole society to a value of forests and therefore believed thoroughly in a people's organization to express and to fight for a new policy which he realized would not advance itself any more than any other worth-while idea would advance itself. Further he did not fret because results were long in coming. He had infinite patience and laughed often at some who would reform the world over night with a few items of newspaper publicity.

Nor was he jealous of his leadership which was acknowledged by those whose judgment was not warped by their own self interests. He frequently refused to correct misstatements of facts because "there is plenty of credit for all of us."

Dr. Rothrock was a man of vision but he had the facility of doing the hard work necessary to make those visions come true. Southey in his *Life of Nelson* states of Nelson what is equally true of Rothrock, "He has left us, not indeed his mantel of inspiration, but a name and an example which will continue to be our shield and our strength." And "Thus it is the spirits of the great and wise continue to live and act after them."

TOWN FORESTS—A NEGLECTED OPPORTUNITY

By HARRIS A. REYNOLDS
Massachusetts Forest and Park Association

There are hundreds of towns scattered throughout the eastern states where lumbering and wood-using industries were once an important part in the economic life of the community. Abandoned mill-sites stand like tombstones to these dead industries. Many declining towns can trace the chief cause of that decline directly to the abuse of the natural resources, especially the forests. Deserted farms are the complement to denuded forest areas. Little hope of recovery for such communities can be found except through the reestablishment of the forests. The private owner is not likely to undertake this task, but the community itself with state or federal aid can do so. This problem is now in the lap of the forestry profession. What shall we do with it?

THE ultimate purpose of forestry is so to manage the forest lands of the country as to insure an adequate timber supply and to obtain for the owners and the public the maximum subsidiary benefits to be derived from such lands. Most of our forest land is in private ownership and only a small fraction of the owners are really practicing forest management. For many years we have been striving for a better approach to the private forest problem, but as yet the formula for its solution has not been written. There are those who still hold with Fernow that "Forestry is a function of government," but we know that governmental agencies cannot acquire all of the forest lands, nor is it desirable to regiment our forest owners through government regulation. It is doubtful whether we know enough about forest management to be able to tell the private owner how he must spend his own money, in the handling of his property. The examples of successful management by foresters of their own woodlands are still too few to be conclusive evidence of our superior knowledge. Losses due to mistakes on public lands are distributed among all the people, but when an error is made by the individual he alone must bear the brunt. It would seem wiser therefore for us first to demonstrate the advantages of forest management on public land and in that way influence the private owner to adopt better practices. For the most part our publicly-owned lands at present are too far removed from the average private owner to enable him to learn through personal observation. This, we believe, can best be accomplished through the establishment of town forests, which will bring the benefits of public forests closer to the people.

The community or town forest in most countries in Europe outranks in area and importance the state and national forests. In this country we have the reverse order, simply because it was easier in the beginning to sell the idea of public ownership and management of forests to the nation than to the municipalities. The United States already owned large areas of forest land, hence no expenditure was required for purchase of the original national forests. Later, when the proposal to buy lands for that purpose was made, under the Weeks' bill, ten long years were required to persuade Congress to pass that legislation. In a democracy, progress in any field is largely dependent upon public education, and the town forest, which is a small edition of the national forest, corresponds to the salesman's samples in demonstrating the value of public forests.

The establishment of town forests should therefore go hand-in-hand with the creation of national and state forests. Although many states now have laws permitting towns to acquire and develop forests, and in some, special encouragement is given in the form of free planting stock and technical advice, yet the town forest has not taken its rightful place in our conservation pattern. The answer may be found in the fact that for every forester who has seriously advocated town forests, at least a hundred others were actually employed on state and national forests, and naturally their first interest was the extension of such areas.

As a means of provoking discussion and at the risk of odious comparison, let us examine the relative merits of national and town forests. A large part of the present acreage in western national forests is rough, mountainous country, where the soil is of low quality and the growing season short. Much of this land falls into the third quality site classification and indeed large areas are located above timber line. When a crop is finally produced, it is frequently so inaccessible that it is not worth the cost of logging, although it may serve a useful purpose for soil

and water conservation. On the other hand, the town-owned forest is generally located in the vicinity of good agricultural soils, and where areas have been taken for the protection of water supply they often contain lands formerly in farms. A high percentage of such lands in the East is first quality site. It might not be a bad guess to say that, on the average, twice as much timber can be produced on the acre of town forest as on the acre of national forest.

Stumpage values are even more favorable to the town forest. On the western national forests the stumpage price for the average timber sale is about $2.50 per thousand, while on the town forest in the East the average stumpage price ranges from $6 to $8. These prices of course vary widely depending upon the location of the timber and general business conditions, but the above figures represent a fair comparison of timber values for the two types of forest.

Transportation costs show still greater differences than stumpage values and production. Long rail or truck hauls are the rule rather than the exception in getting western timber from the forest to the mill; whereas, a single short haul may place timber and other forest products from the town forest in the hands of the ultimate consumer. Even after the logs from the western national forests have been converted into lumber a $14 gross water freight charge per thousand, or a $15 to $20 railroad rate must be met to land it at Boston and many other points on the eastern seaboard, an important market outlet for such lumber. When it arrives there it must be handled two or three times more before it reaches the consumer. Under such handicaps only the very best quality of lumber can bear these charges and still meet competition, which means a heavy waste in the lower grades. On the town forest much closer utilization is possible, where even the limb wood may have enough value for fuel to justify its removal from the forest. One thing is certain that a large part of the cut on a town forest either is consumed by the town itself or by its citizens and the local factories. Thus with the local market assured more intensive management is justifiable on the town forest than on the national forest.

There are many other factors where comparisons cannot be reduced to figures, but where the values involved are just as real. For example, the laborers on the established town forest have permanent jobs and can live at home, while much of the work on timber sales on the national forests is done by contractors with a floating population. The town forest helps to stabilize local employment, and in periods of industrial depression, temporary employment is given to many men in the forests, especially in the winter when other outdoor work is not available.

In the matter of water conservation, the difference in the value of these areas is not so marked because water is the economic lifeblood of many western communities. However, in the case of domestic water supply the town forest acre serves a much larger population than the national forest acre, while for irrigation the reverse is true. Water power is of course a big item to the credit of the national forests, but on a smaller scale the town forest serves the same purpose. The power derived from the water supply of the city of Springfield, Mass., under a long-time lease, will amortize the construction expenditures and in the long run will meet a large part of the cost of water to the consumers. In a greater or less degree this plan is applicable to many other places. The watershed for the conservation and protection of the water supply is generally owned by the city and placed under forest management.

Thus far, the greater part of the forest land owned by cities and towns is used primarily for domestic water protection, but this function does not interfere with the production of timber. In fact, many water boards are looking forward to a regular income from this source which is expected to reduce the cost of water to the local consumers. The city of Westfield, Mass., for example, expects within the next three decades to be able henceforth to make an annual sale of about $20,000 worth of forest products from its 5,400 acre forest.

One of the large income items on the national forests is derived from grazing. In the East grazing is quite generally considered incompatible with timber production and is not permitted on the town forests. In fact, grazing is a separate form of agriculture, which should not be coupled with forestry, except as a matter of administration of lands which have not been or cannot be reforested.

As to wildlife protection and propagation, the national forest has the edge on the town forest, especially for large game, yet the town forest, which is frequently a bird and game sanctuary, is an auxiliary small game refuge, supplementing the large state refuges. The wild-

life found in the town forest is a great attraction and source of pleasure to children who have no opportunity to see either national or state forests. It is difficult to reduce this value to money terms, but in certain European community forests considerable revenue is obtained from sales of hunting permits and in the larger town forests here, that procedure is at least a possibility.

Recreation is a by-product of any public forest, but the town forests, especially those not used for water protection, are self-supporting wild forest parks, thus reducing the cost of park facilities to the community. Thousands of people who have neither time nor money to visit state or national forests can be provided with this type of recreation within easy reach of their homes. The town forest therefore fills the recreational needs of a much larger number of people per unit of area than other types of public forests. Furthermore, this recreation is available at all times of the year, while only periodic visits to national or state forests can be enjoyed by most of the people who are privileged to use them.

In drawing these comparisons there is no thought of minimizing the value of national forests, but rather to show that if the same energy was applied to the advancement of town forests that has been expended on national forests, the economic benefits per unit of area would be far greater. It is conservative to say that on the average an acre of town forest is worth at least fifteen acres of western national forest in our present social and economic structure. In other words, 10,000,000 acres in town forests now would produce benefits to society equal to our present national forests and surely more than that acreage in this country is capable of being converted into town forests.

Perhaps the greatest value of the town forest at this stage lies in its inherent educational possibilities. To the average Easterner, the western national forests represent a fine ideal in conservation, but he has never seen nor expects to see one. It never occurs to him that such forests mean any expense to him. But, when the question of establishing a town forest comes up in the town meeting, he knows that the cost will appear in his local tax bill. Therefore, when a town votes to acquire land for the development of a forest, that town is well on the way to become forest-minded. Many of the local taxpayers own woodlands, and since it is their money that is being used in the creation of the town-owned forest, they have more than a passing interest in it. They want to know whether it is a paying proposition and what must be done to make it pay. A demonstration in forest management on private land is often useless because of a change of ownership and consequent abandonment of the project, but such a demonstration on a town forest can be carried throughout the rotation. The selfish interest of the forest-owning citizen in the town forest leads him directly into the consideration of practicing forestry on his own lands.

To persuade a town to acquire and operate a forest requires no small amount of public education. For more than a quarter century the Massachusetts Forest and Park Association has had the establishment of town forests on its work program. During that time, however, we have had a World War and a major depression, each of which stagnated this type of civic improvement. Besides, the town forest was a new idea with no local precedents and the association had little money to devote to the project. Yet, there are now 105 town forests out of a possible 300 places that contain land suited for that purpose. The aggregate acreage is just under 31,000, or an average of about 300 acres per forest. We know that the number of forests and the average acreage can be greatly increased, especially the latter. Two-thirds of the present area in town forests is used for protection of the water supply and some 50,000 acres more are now owned by cities, but which have not yet been placed under the Town Forest Act.

The size of the town in population has little relation to the area of its forest. For example, the little village of Russell, Mass., with 1,283 citizens, owns 3,000 acres. Many small villages in Europe own large forests. With more than 36,000 cities, towns and villages in this country, the possibilities of the town forest as a factor in conservation is of major importance.

The town forests should be managed by technical foresters, and here is a potential field of new employment for young foresters that may equal the possibilities in state forests or even in the national forests. Under intensive management, including the multiple uses of such areas, a forest of 5,000 acres is large enough to justify the services of a forester. Ten million acres in town forests therefore should give employment to about 2,000 foresters. There are hundreds of small places that could use a forester to advantage

in the care of their parks and public shade trees, but they do not have enough work to give him full-time employment. If, in addition to parks and shade trees the town owned a forest, the forester might be given regular employment. There is also the possibility of the forester managing the forests of two or more towns as is the practice in Europe, and under a part-time arrangement he could supplement his income by advising private woodland owners.

This form of public ownership is highly desirable, but the big problem is to sell the idea to the public. The recent study of the subject by the U. S. Forest Service and the consequent publicity have already given it considerable impetus. Since the initial job is public education and legislation, recommendations should be made to the Joint Congressional Committee on Forestry to determine what help the federal government may render to cities, towns and villages under present laws, such as the Clark-McNary Act or what amendments to such acts may be desirable. In the states which do not now permit the communities to own forests, bills should be introduced to grant that authority. Where such forests exist or the laws provide for them there should be set up a division of town forests in the department of forestry or conservation to aid the communities in the acquisition and management of such forests. Here also is an opportunity to do considerable educational and research work by the establishment of demonstrations in forest management within the town forests.

THE APPROACH TO FARM FORESTRY[1]

By JOHN F. PRESTON[2]
Soil Conservation Service

About 30 percent of the total forest area and about 40 percent of all privately owned forest land is in farm woodlands. In general farm woodlands are overcut and overgrazed. Mr. Preston has attempted to analyze the various factors contributing to the present condition of farm woodlands. He proposes the establishment of a thousand or more cooperative demonstration farm woodlands from which yield and financial data would be collected for twenty-five years or more. If the returns from farm woodlands are what foresters at least hope they are these demonstration woodlands would go far in making a realistic approach to the problem possible.

FARM forestry is one of the most baffling forestry problems in the United States. I wonder if we have tackled it in the right way? Have we ever really analyzed the problem, surveyed its difficulties, picked out points of attack, selected the vulnerable spots? Has profound and constructive thought been given to the planning of a farm forestry campaign? If the answer is in the negative, would it not be a good time to start?

In the last few years, recruits have joined the farm forestry army. The Soil Conservation Service has built up its Woodland Section—a corps of between three and four hundred foresters. C.C.C. camps have dotted the landscape throughout the length and breadth of the country, and many of them have been used to demonstrate to farmers on farm woodlands better methods of cutting timber. In recent years, the U. S. Forest Service has built shelterbelts for farmers of the Great Plains—a new venture in farm forestry. Still more recently, Congress passed the Cooperative Farm Forestry Act, and the old shelterbelt project has become the Prairie States Forestry Project. This act, with the prospect of federal appropriations to make it effective opens up new possibilities in the campaign for farm forestry. The Extension Service and the state foresters have, of course, been working at this problem for twenty years or more. The A.A.A. program of benefit payments is pointed toward promoting farm forestry. Would it not be well to get all of the different agencies together and plan a campaign based upon a thorough analysis of the problem so that every agency would carry out its work as a part of a unified plan?

This is an attempt to make a little preliminary analysis of the problem, and perhaps stimulate

[1]Received for publication August 1938.

[2]The views expressed herein are those of the author and they do not in any way reflect officially the attitude of the Soil Conservation Service.

further action. This is a forester's problem and the analysis should be from the standpoint of forestry; not from the point of view of any one federal or state agency.

Let us look at the farm forestry problem in perspective. The last census gives a figure of 185 million acres of farm woodland. We used to figure about 125 million acres. But whichever figure is right, a large area of forest land is included in farm woodlands. If we use the last census figure, farm woodlands account for about 30 percent of the total forest land of the country, and 40 percent of all privately owned forest lands. The necessities of the situation, the economic advantages which will arise from the practice of forestry will, in my opinion, bring about satisfactory forestry administration of the privately owned forest land not in farm woodlands, some 250 million acres, classified as commercial timber lands.

At the present time, forestry schools are graduating hundreds of foresters who will not find employment in the public service. Many of them will take whatever jobs are available in the wood-using industries. We know that the acreage of forest land is large enough to require the services of a goodly number of foresters; and we know that foresters can render a service that will justify their employment just as soon and just as rapidly as economics permit the use of land for future crops of timber. That time is coming probably much sooner than most of us think. These young foresters who will get into the wood-using industries as clerks, swampers, and cruisers are going to emerge, at least a portion of them, as full-fledged foresters or as executives who will be in a position to employ foresters to help run the business. This 60 percent of our privately owned forest land is going to be under the supervision of foresters, and will be taken care of more or less as the logical development of the forest business.

The other 40 percent, however, is in a different class. One hundred and eighty-five million acres, constituting 16 percent of the total farm land of the country distributed unevenly over 6 million farms, is a sizable forestry problem. Roughly, in the eastern United States, there are 147 million acres of farm woodland, or about 25 percent of the total farm area. These forest lands are scattered in tracts from a few acres to several hundred acres, but in very few cases are they sufficiently large to justify the employment of foresters. Comparatively few farmers are foresters. Generally, farmers oppose forests as a crop. They and their forbears have been fighting the wilderness too long to look with complacency upon the idea of the forest as a crop. But we know, as foresters, that if agricultural prosperity is to be realized, more farmers must become foresters. Silviculture must be recognized as a part of agriculture, in the same way that agronomy and animal industry are.

Foresters must recognize the fact that agricultural workers—county agents, agronomists, agricultural engineers, teachers of agriculture—generally hold very much to the same philosophy as farmers with respect to farm forestry. They do not recognize the forest as a productive unit of the farm, but as a waste area—simply a part of the farm that cannot be used for field crops or pasture. The idea that the farm woodland is a productive unit of the farm must first be accepted by agricultural workers if we are to succeed in getting the farmers to accept it. "Every acre of the farm must produce its fair share of the farm income," should be the slogan of every agricultural worker and of every farmer.

Woods appreciation by the farmer is the key to the whole farm forestry campaign. Foresters must realize that their success in developing such appreciation will be in keeping with their ability to convince the farmer of the intrinsic value of his woods. Forestry can be applied to farm woodlands only by making foresters out of farmers; in this field, forestry must be applied vicariously.

As I see it, the situation may be summed up in the following discussion and an explanation made as to why we have not made as much progress as might have been expected.

The general lack of appreciation of the farm forestry possibilities by agricultural workers has been one of the difficulties. In the Soil Conservation Service, foresters constitute approximately 10 percent of the total professional personnel. This organization failed to make much progress in forestry until the other 90 percent became aware of the value of the farm forestry program. Too often the farm maps of a few years ago, picturing an erosion-control plan, showed the wooded part of the farm simply as a blank. Even though sometimes 40 or 50 percent of the farm was covered with woods or brush, it was thought of as just so much waste land. Naturally, progress in developing a forestry program was slow until foresters succeeded in convincing their fel-

low workers "that every acre of the farm must produce its fair share of the farm income."

Foresters must accept the responsibility of making the farm woodland productive, and the other agricultural workers must accept the philosophy that the average farm cannot succeed unless forestry does pay its way.

Farm forestry must be taught in all agricultural schools so that graduates will emerge with a working knowledge of farm forestry, able to teach fundamentals of farm woodland management. Farm forestry cannot be divorced from the whole series of farm problems. Tenancy, farm income, absentee ownership, literacy—the whole array which make up our agricultural problem—are of vital concern and interest to foresters. We can expect farmers to take no better care of their woodland than they do of their corn fields. Farm foresters must first of all be agriculturists, and secondly foresters.

If agricultural workers in general have failed to recognize the part which farm forestry can play in farm economics, it is also true that foresters have failed to recognize the intimate relation between forestry and farm economics. Farm forestry must be approached from the standpoint of the farmer. The forester must understand the relation of woods to pasture; the relation of the woods to the farm requirements for forest products. He must recognize the necessity for outlining a plan of management and of silviculture that will meet the farm requirements for wood products. Silviculture in the abstract will not do for the farmer; silviculture to develop particular products which he can use or sell, is the only kind that he can understand.

In my opinion, foresters have tried to persuade farmers to adopt silviculture too much for its own sake. We have spent a lot of time and energy in timber stand improvement plots in farm woodlands, showing the farmer how to cut timber, and in other plots showing how to mark it. We have put "blue ribbons" and "white bellies" on selected trees and in other ways have spectacularly and ostentatiously marked crop trees. We have had farmer gatherings in order to exhibit our skill. I have visited many of these plots in company with groups of foresters, and have felt and seen the lack of enthusiasm of the foresters themselves. The experience has caused me to wonder just how much the farmers learned from such examples. Perhaps the incentive in terms of what it means is lacking.

Simple plans of management will, in my opinion, often reinforce silviculture, will interpret and give it meaning, and will furnish the desired goal of silviculture. Obviously, if a management plan for every farmer's woods is to precede attempts at teaching silviculture (and I do not say that it should precede every attempt), then simpler methods of making such plans than the foresters now use must be found. In fact, a different conception of a management plan than is taught in the forest schools as a part of "big woods" forestry is needed. The problem actually gets down to one of making a quick analysis of the individual farm woodland, and, after analysis, to prescribe simple corrective measures but these measures must carry a meaning to the farmer in terms of what the goal of silviculture is.

It is obvious, I think, since farm forestry is so intimately tied up with the general agricultural problem that foresters should not expect even a moderate degree of success on all farms. Farms must be selected that are adaptable to farm forestry, and are owned by farmers who are willing to cooperate. Incidentally, these farmers are usually progressive in other lines of agriculture. It is very natural that a tenant farmer does not have the same interest in the farm woods as has the owner. The degree of interest is also related to the income status of the farmer. If his financial status is such that he must cut every tree that has any value, in order to keep from starving, it is futile to ask him to spare an eight-inch tree which may now be worth 50 cents, until it grows to be 18 inches and worth $1.50. He is simply not in a position to be interested in future values. Therefore, progress in the intelligent management of farm woodlands can be made with only part of the woodland owners; there must be a selection of farmers. Just what the basis for selection should be, just what weeding out process should be used, is still a moot question.

I would like to suggest the following tentative program for farm forestry[3]:

1. The U. S. Forest Service as the technical authority in forestry, will, of course, be expected to lead in farm forestry work, and with the added impetus of the Farm Forestry Act, should, as ap-

[3]The Secretary of Agriculture contemplates an attack on the farm forestry problem (if the pending appropriation is made available [April 1939]) partly through farm forestry projects which are intended to accomplish essentially what is advocated in this paragraph.—*The Author.*

propriations become available, be able to do a great deal more than it has in the past. In addition to the research work that it is now carrying on at the various forest experiment stations, I suggest that not less than a thousand cooperative management studies be undertaken in selected farm woodlands throughout the eastern United States. I conceive of a relationship whereby the Forest Service, either separately or through cooperation with the state foresters, undertakes the management of 1,000 different farm woodlands, under a 25-year cooperative agreement. The Forest Service or the state forester will act as consulting forester to the farmer; a management plan will be prepared, and cutting regulated and carefully supervised. The consulting forester would naturally take an inventory of the woods, and keep track of the timber which is cut, its character, volume, and value. At the end of 15, 20, or 25 years, we would have an exact record of the condition of the woods at the beginning of the management period and the growing stock at the end of the period, together with the exact quantity cut in the meantime, and the income received by the farmer. Perhaps it would be necessary to pay the farmer a nominal sum per acre to induce him to handle his woodland under such a plan, and it might be advisable to have the agreement "run with the land"; that is to be binding on any future owners of the land for the period of the agreement. If we had a thousand or more such examples of actual management, it would, in my opinion, do more than any other one thing to convince farmers and agricultural workers of the value of the farm forestry program. It would furnish concrete evidence, which is now lacking, of the results of systematic management of the farm woodlands. Farm forestry is a long-time job and 25 years is a relatively short time in which actually to demonstrate what sensible management will bring about.

2. The cooperative marketing undertakings of the Extension Service and the Forest Service should be continued at every favorable opportunity. Their present undertakings are highly commendable.

3. The general educational work of the Extension Service should be continued. The very nature of the farm woodland problem, however, would seem to put some limitation upon the amount of money which should be invested in general educational work in farm forestry. Just what the limitation should be is a matter for discussion. Progress, in my judgment, depends, first of all, upon building a foundation of factual data derived from experience in actual management of farm woodlands over a period of 15 to 25 years. Secondly, it depends upon intimate contact with the individual farmer's whole farm problem and the dovetailing of the plan of woodland management into his farm plan. Extension forestry along the lines of cooperative management and marketing seems to me to promise substantial results. Educational work along the lines of farm forestry bulletins, meetings, and exhibits undoubtedly has a place in the farm forestry program but there must be an upper limit for such efforts. My belief is that, until we have laid a better ground work and made a more complete analysis of the problem, it would be advisable to weigh carefully any programs for a considerable expansion of generalized educational activities.

4. Individual consultations between foresters and selected farmers, where the forestry problem on particular farms is analyzed and tied in to the farm plan, is perhaps the surest method, but obviously it can be applied to relatively few farms. Compared to the whole field, this is a restricted effort but it may help in building the foundation upon which all foresters can build. This class of farm forestry work is now being put into effect by the foresters in the Soil Conservation Service and to some extent by the state foresters and the extension foresters. This is the class of work which I have called silviculture reinforced by management—forestry as an integral part of the farm organization.

We need a 25-year plan for farm forestry. We need to have a careful analysis of the problem and of the part each of the different agencies should take in its solution. A coordinated and well planned attack is much more likely to succeed than the present uncoordinated and more or less unrelated efforts.

THE EFFECT OF STERILIZATION WITH CALCIUM HYPOCHLORITE ON GERMINATION OF CERTAIN SEEDS

By J. NELSON SPAETH and M. AFANASIEV
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Although the retarding effect of calcium hypochlorite on the germination of seeds is not universal the authors show that it not only retards the germination of certain forest tree seeds but also greatly reduces the germination percentage.

SINCE the introduction of calcium hypochlorite as a seed sterilizing agent (*1*) this chemical has been used widely in seed investigations as well as in practical handling of seeds in storage. On the basis of the early literature some workers seem to have taken for granted, the ability of calcium hypocholorite to destroy bacteria and fungi without altering normal germination processes in seeds. The treatment commonly employed is to soak seeds for two hours in a solution made up in the proportion of 10 grams of calcium hypochlorite to 140 c.c. of water. The authors found that in some species such treatment affects both the rate of germination and the final germination percent of certain tree seeds.

In a study of seeds of *Magnolia acuminata* (*2*) the standard calcium hypochlorite treatment, referred to above, was found to affect germination markedly. Germination of unsterilized seeds was found to be considerably more rapid, and the total germination higher than that of sterilized seeds. The differences in final germination percent between sterilized intact seeds and naked kernels practically disappeared when the tests were run with unsterilized seeds (Table 1).

These findings led to an investigation of the effect of calcium hypochlorite on germination of seeds of a few other arborescent species as well as to checking the original results on magnolia seeds. The results of this investigation are summarized in Tables 2 and 3. The standard solution of 10 grams of $CaOCl_2$ in 140 c.c. of water was applied for two hours in all cases.

The behavior of seeds of *Magnolia grandiflora* under the influence of $CaOCl_2$ was very much the same as that of *M. acuminata* seeds. Their germination was considerably delayed and the total germination markedly reduced when the seeds were treated with the chemical. In both species the adverse effect of sterilization was particularly pronounced in the case of seeds from which the lignified seed coats had not been removed. Relatively low germination percentages in seeds of *Magnolia grandiflora* were observed and reported by Miss Evans (*3*) who used calcium hypochlorite for sterilization. Failure of the sterilized intact seeds to germinate led her to the conclusion that "the cause of the delay in germination lies partly, but not wholly, in the lignified seed coat." In view of present findings in respect to germination of *M. grandiflora* seeds it seems likely that the delay attributed to the seed coat was largely the result of sterilization rather than of the character of the seed coat itself.

The final germination percentages of sterilized and unsterilized seeds were not materially

TABLE 1.—GERMINATION OF STERILIZED AND UNSTERILIZED MAGNOLIA SEEDS WITH AND WITHOUT SEED COATS

Species and condition of seeds	No. of seeds	Days in germinator: 3	6	9	12	15	18	21	24	27	30
		Germination percent									
Magnolia acuminata											
Intact seeds											
Unsterilized	50	....	...	......	74.0	84.0	86.0	86.0	86.0	88.0	88.0
Sterilized	50	----	----	----	----	----	----	----	4.0	8.0	14.0
Naked kernels											
Unsterilized	56	----	----	18.0	64.0	71.0	79.0	79.0	80.0	80.0	80.0
Sterilized	25	----	----	0.0	12.0	20.0	48.0	52.0	56.0	56.0	60.0

[1]Since the preparation of this article, the authors have become respectively, head, Department of Forestry, University of Illinois, and associate professor of horticulture, Oklahoma Agricultural and Mechanical College.

different in any species tried. Since the difference in favor of unsterilized seeds was persistent throughout the list, however, (Table 3), it should be attributed to the influence of calcium hypochlorite. Another evidence of the interference of sterilization with normal germination processes was observed in a persistent and definite delay of the initiation of germination. In all cases germination began earlier in unsterilized seeds. Still more pronounced delay in germination of black cherry and red oak was observed in earlier tests using seed not as fully after-ripened as those used in the tests recorded in Table 3.

Of the seven species investigated *Robinia pseudoacacia* was affected least by the sterilization treatment.

The retarding effect of calcium hypochlorite on germination of seeds is by no means universal. Wilson (*1*) has shown that this chemical may be applied effectively and without any adverse effect to seeds of many species. In the practical handling of some seeds a slight delay in germination, such as exhibited by most species in the present investigation might not be of great importance. However, since there are at least some seeds, the germination of which is markedly retarded or reduced by this common sterilization procedure, it seems advisable to investigate the effect of calcium hypochlorite on the germination behavior of any species before using it in experimental work or on an extensive scale.

Literature Cited

1. Wilson, J. K. 1915. Calcium hypochlorite as a seed sterilizer. Amer. Jour. Bot. 2: 420-427.
2. Afanasiev, M. 1937. A physiological study of dormancy in seed of *Magnolia acuminata.* Cornell Univ. Agric. Exp. Sta. Memoir 208.
3. Evans, C. R. 1933. Germination behavior of *Magnolia grandiflora.* Bot. Gaz. 94: 729-754.

Table 2.—Germination of Sterilized and Unsterilized Magnolia Seeds With and Without Seed Coats

Species and condition of seeds	No. of seeds	Days in germinator 2	4	6	8	10	12	14	16	18	20
		Germination percent									
Magnolia acuminata											
Unsterilized	100	—	—	—	14.0	52.0	60.0	61.0	62.0	63.0	63.0
Sterilized	100	—	—	—	—	—	—	—	—	—	0.0
Magnolia grandiflora											
Intact seeds											
Unsterilized	30	—	—	—	13.3	23.3	53.3	70.0	83.3	86.6	90.0
Sterilized	30	—	—	—	—	—	3.3	3.3	6.6	10.0	10.0
Naked kernels											
Unsterilized	11	—	—	—	18.2	55.5	63.6	81.8	90.9	100.0	100.0
Sterilized	10	—	—	—	—	—	30.0	40.0	40.0	50.0	50.0

Table 3.—Germination of Sterilized and Unsterilized Forest Tree Seeds

Species and conditions of seeds	No. of seeds	Days in germinator 1	2	3	4	5	6	7	8	9	10
		Germination percent									
Quercus borealis											
Unsterilized	90	40.0	53.3	63.3	76.6	78.9	86.6	87.7	92.2	97.8	100.0
Sterilized	90	—	22.2	40.0	54.4	65.5	67.8	70.0	74.4	75.5	83.3
Fraxinus americana											
Unsterilized	100	5.0	12.0	16.0	17.0	—	—	—	—	—	17.0
Sterilized	100	—	7.0	10.0	11.0	—	—	—	—	—	11.0
Prunus serotina											
Unsterilized	100	2.0	20.0	40.0	53.0	57.0	73.0	74.0	75.0	76.0	76.0
Sterilized	100	—	3.0	6.0	29.0	38.0	62.0	65.0	67.0	72.0	73.0
Betula papyrifera											
Unsterilized	100	—	—	37.0	—	—	—	—	—	—	37.0
Sterilized	100	—	—	25.0	28.0	30.0	—	—	—	—	30.0
Robinia pseudoacacia											
Unsterilized	103	4.9	68.0	78.6	84.4	88.3	94.1	94.1	95.1	96.1	98.1
Sterilized	100	1.0	49.0	69.0	74.0	81.0	83.0	86.0	89.0	91.0	91.0

THE CANADIAN NATIONAL RAILWAYS AND THE FORESTS OF CANADA

By W. H. KILBY
Canadian National Railways

The mutual dependence of a great industrial concern and a great natural resource is shown. Fire protection is a paramount requirement to both. Methods and results are given. Industrial responsibility in the public interest is recognized. Education is the greatest need in the larger aspects of forest conservation. The author is Supervisor of Fire Protection for the Canadian National Railways.

THE development of the Dominion of Canada has been made possible by its extensive railway systems, and conversely the natural resources of Canada have made possible this railway development. The latter statement applies particularly to the Dominion's vast forest supplies.

The Canadian National Railways has learned, with others, that the boasted inexhaustibility of Canada's forests is an expression which should be used guardedly. It is quite true that Canada, like other countries rich in forest resources, has been extravagant and careless, but it is equally true that as national maturity proceeds, the importance of scientific conservation and utilization is assuming its rightful place in the Dominion's economy and progress. This matter must not only be brought to public attention, it must be kept alive and advanced by sound legislation and just law enforcement. Forest conservation is primarily educational. Much may be learned from the experience of others; but our own experiences are and will be our best teacher. The law of itself does not put out fires. The only policeman worth while in our forests is the man who polices himself.

There are many hopeful signs that progressive forest protection measures in their broadest sense have advanced from theory to practice. We still have, however, a long hard road ahead. Indeed, it is a fact that the need of forest protection in all its branches—fire, disease, insects—is greater today than ever before, but there is no need for undue alarm if we "be not weary in well doing."

At times it appears that foresters have not always realized the important relation between a country's forests and its railways. The latter, despite the great strides made in other methods of transport, still are the main conveyor belt of an unified national industrial machine, and they will continue to move safely and quickly the great bulk of natural and industrial products. The interest of Canada's transcontinental railways in the forests and all they mean is second only to those interests directly engaged in the removal, manufacturing, and marketing of forest products.

It may be well to consider separately the Canadian National Railways' actual connection with Canada's forests, what forest products are needed and their cost, what is transported, what part the forests play in attracting tourists, how forest denudation affects track maintenance and costs, what fire preventive processes and protective measures are practiced, what wood preservation methods are used and to what extent, and last, but no means least, how some 80,000 people have developed a forest consciousness.

This railway system has about 22,000 miles of active trackage, some 1,840 of which are in the United States, and the balance in Canada. It requires no great effort of the imagination to realize how largely forest products enter the railway's needs. To carry the steel rails some 60,000,000 cross ties are required. When untreated wood was used, a complete renewal of ties was necessary in less than ten years. The life of treated ties is much greater, but treatment does not add to the mechanical life of the tie.

The average yearly purchase of cross ties is about 8,000,000, but in order to give a complete picture of a fairly typical year, the year 1925 may be taken. This year gives an idea of what may be regarded as normal, neither expanded nor depressed. In 1925 a total of 9,826,970 ties was purchased in order to take care of current needs and to provide a supply of treated ties for future needs.

About 93 percent of the ties purchased are softwoods and 7 percent are hardwoods. The purchase of ties is fairly divided among the forested provinces. British Columbia, Alberta, Ontario, Quebec, and New Brunswick supply the major part of the railway's needs. Jack pine, spruce, fir, and tamarac provide possibly 90 percent of the softwood ties; the hardwoods, red and white oak, beech, birch, elm, and maple, furnish the

remaining 10 percent. All these hardwoods are becoming scarce and are obtained almost exclusively in the eastern provinces and states.

The cost of ties in 1925 exceeded $7,000,000; the average cost of an untreated tie is 76.07 cents, and an additional 3.23 cents for tax and inspection brought the total cost up to 79.30 cents per tie. Some 2,620,760 ties or 26.58 percent of all ties purchased were treated with creosote at a cost per tie of 73.65 cents, making the final cost $1.53.

In 1906 the average cost of an untreated tie was 40 cents; in 1925, 79 cents; and in 1937, 63 cents, an interesting comparison reflecting economic conditions. This cost relation has extended to other wood materials used by the railways so that, while requirements and costs have decreased in the last decade, the standard of maintenance has been continued.

So many products are used by railways that it would be difficult to prepare a complete list of them. While cross ties are the largest single item, switch ties, piling, telegraph poles, fence posts, grain doors, track shims, lumber in its many forms, and furniture are items representing a considerable cost. In 1925 the total purchases of material or articles derived from the forest approximated $14,000,000.

More than 17 percent of the total freight tonnage of the Canadian National Railways is forest products. Freight traffic in forest products in British Columbia during 1925 represented 60 percent of all tonnage originating in that province. Lumber in its many forms was first with 4,629,400 tons, pulpwood with 2,566,915 tons was second, and miscellaneous forest products accounted for 2,318,828 tons, a total of 9,515,143 freight tons. In 1937 less than 7,000,000 tons were handled. This is a barometer of trade conditions.

It is difficult, if not impossible, to segregate from general railway income the amount of revenue derived from tourists who spend their vacations in forested areas. Jasper National Park in western Alberta, a truly scenic jewel, is a tourist magnet because of its varied beauty in which mountain, lake, and forest are effectively combined. Without the trees, which at certain seasons are a riot of color, the setting would be absent and the attraction cease to exist.

Hunting grounds, lakes, and fishing streams throughout Canada provide a never-ending source of pleasure and health to many thousands of people and a substantial leisure travel revenue to the railways. Without tree growth and the color it provides, without the purifying effect of slow water filtration through the covering of the forest floor, the hunting and fishing attractions would be seriously affected and sometimes destroyed.

The tourist trade of Canada—it has totaled $500,000,000 in a single year and possibly its average for the last ten years would be over $300,000,000—circulates much money in which the railways share. In our estimates of forest losses we often fail to take into account the indirect losses, such as wildlife, recreational value, and other items, which may amount over a period of time to a far greater total than the value of the timber destroyed.

The cost of track maintenance due to excessive water flow, occasioned to a larger degree by forest denudation and to a smaller degree by drainage systems, is difficult to estimate, but as everyone in touch with this situation knows, when the forest floor is destroyed causing rapid water run-off, placid woods streams at times become raging torrents.

Track engineers may allow for a predetermined water run-off in their bridge openings or culverts in forested lands, but when the forest is destroyed their calculations often are badly upset. The growing forest, with its steadying effect on water flow and storage, is an important feature in track maintenance, particularly where the natural flowage of the watershed is across the track.

Without attempting to dissect an organization of the magnitude and functional variety of the Canadian National Railways, its forest protection activities will be described briefly. Forest protection is essentially a function of the Operation Department, which is responsible for the upkeep of mechanical power, the movement of trains, and the maintenance of track and properties.

The work is conducted from the four regional headquarters, three in Canada and one in the United States. In each region is a Supervisor of Fire Protection, who interprets and effects the requirements of the Board of Transport Commissioners in Canada and the laws and regulations of state and federal authorities in the United States.

Believing that it is most important to prevent fires before they start, careful attention is given to the mechanical appliances on locomotives or other steam engines.

Locomotives have undergone great changes and it is a far cry from the "cone" or diamond

netting on the stack to the modern master mechanic front end, the internal barrel netting, baffle plates, and other devices which combine to make the effective spark arrester of today. Ash pans are now equipped with deflectors and dump pans with positive locks which can be operated only by a special dumping lever from the ground. Slush pipes lead into ash pans and thoroughly drench the hot cinders as the fires are cleaned and the ashes dumped.

Oil burning locomotives are used in the fire hazardous and heavily timbered part of British Columbia. This form of fuel for power development is not in itself proof against the starting of fires, but the chances are reduced to a minimum. Flues must be regularly sanded to expel accumulated soot. Oil burning locomotives, in use on Vancouver Island, are now fitted with nettings as an added precaution.

Fires from locomotives have shown a marked decrease due largely to mechanical improvements, the use of better grade of coal, better care of appliances, and to paying greater attention to reports which permit fire causes to be more accurately determined.

The rigid inspection of locomotive coal at the minehead to eliminate foreign matter, a cause of excessive sparking, has been a valuable contribution. The Board of Transport Commissioners' requirements on sub-bituminous light grade coals, confining their summer use to prairie sections and their general use when the ground is snow covered, is a wise precaution.

Frequent inspection of fire prevention appliances has served the dual purpose of enforcing excellent maintenance and of educating the mechanical staffs to the importance of the work. Inspection is performed and reports submitted by railway employees. Check is provided by Transport Commission inspectors.

Organized railway forest, and prairie fire protection was first instituted in a scientific manner in Canada about twenty-five years ago. Some unorganized work had been done prior to that time.

In 1903 the Railway Act was passed. It prescribed measures for the protection of the prairies and for the equipment of locomotives with fire preventive appliances. The first specific order was issued by the Board of Railway Commissioners in 1907. Subsequently, the Railway Act was amended to give the Board of Railway Commissioners greater power to deal with the matter. In 1912 the position of Chief Fire Inspector for the Board was created, and a comprehensive fire prevention order with specific requirements was issued.

Clyde Leavitt, now with Syracuse University, was appointed Chief Fire Inspector, and to him Canada owes a debt of gratitude for the cooperative organization he set up, which remains effective even today. In 1932 the special appointment was discontinued and the work is now administered well by Col. C. C. Stibbard, Chief Operating Officer for the Board of Transport Commissioners, with the able assistance of H. C. Johnson.

Have the vision and action taken in those pioneer days been justified by the results? The official figures for fires of railway origin only are shown in Table 1. All lines are under the jurisdiction of the Board of Transport Commissioners.

TABLE 1.—NUMBER OF FIRES, AREA BURNED, AND DAMAGE DONE BY FIRES OF RAILWAY ORIGIN

Year	Forested mileage	Number of fires	Area in acres burned	Damage
1923	11,347	861	424,407	$681.781
1936	14,030	160	1,368	$843

Figured on an equivalent mileage basis the cash loss for 1937 is about one one-thousandth that of 1923.

It is noteworthy that in 1935 and 1937 the Canadian National Railways, operating through that vast storehouse of softwood timber, British Columbia, did not allow fire from its operation to destroy a single stick of merchantable timber. For a number of years forest losses throughout the 11,000 to 14,000 miles of line traversed by this railway through forested territory have been negligible. In 1910 this statement was made, "Railways are a prolific source of danger to forest land." In 1939 in Canada the railways are one of the leaders in forest fire prevention. At one time railways and forest fires were synonymous; today forest fires are still too prevalent but the railways are not the cause of them.

Of equal importance to accurate information as to the cause of fires is rapid notification, means of communication to fire areas, and effective equipment to suppress fire. Railways are happily situated in all these matters, controlling as they do the different factors which combine to secure effective fire reporting and control. It would seem worth-while for the railways of North America to study fire reporting with a view to developing a standard system, making due allowance for local conditions and organization policies. A fire is very much the same the world

over, and while cause may vary, there are actually comparatively few major causes of railway fires. It should be possible to correlate our efforts to produce forms and a reporting system which will meet general requirements and give standard basic information.

The clearing of railway rights of way is more a preventive than a protective measure. To keep a 22,000 mileage clean and free from combustible matter and debris is a herculean task. Owing to climatic, geographical, and other features it is not possible to lay down set rules defining when the burning of material on rights of way shall be done or how. Men with a knowledge of local conditions are best qualified to handle the problem. A burning torch for starting fire and a packsack or can containing five gallons of water, equipped with hand pump, for controlling burning operations on the rights of way have been found satisfactory.

The small canvas or can reservoir with pump and the portable gasoline pumping unit have proven of inestimable value in forest fire control. In addition, the Canadian National Railways maintain 25 fire-fighting tank cars varying in capacity from 3,000 to 13,000 gallons, equipped with steam and gasoline power pumps. These are stationed at strategic points along the railway and are kept in readiness during the fire season.

Some 14,000 miles of territory are classified as forested and on this mileage special patrol or attention is provided. The closed season, generally from May 1 to October 31 inclusive, is sometimes extended by mutual arrangement between the governmental authorities and the railway management. Patrol is carried out almost entirely by the section forces as part of their duties. This method of patrol has superseded other forms, such as special men using track motor cars. The inclusion of fire patrol in maintenance of way duties has resulted in active interest and satisfactory results. Fire extinguishing equipment is carried on all section motor or other cars operating in forested territory and emergency tools are stored at section tool houses.

On the prairies protection is afforded to adjacent country by plowing fireguards varying in width from 4 to 8 feet and 100 to 250 feet distant from the track. Some six thousand miles of fireguards were plowed or otherwise maintained in the Provinces of Manitoba, Saskatchewan, and Alberta during 1937. Where conditions in forest lands necessitate, fireguards are established and maintained. In a few cases they are as much as 16 feet in width.

On the Canadian National Railways there are some 4,000 timber bridges, exceeding 90 miles in total length. To protect them from fire, absolute cleanliness is maintained around the structural piling for a distance on each side thereof. Metal sheeting or fireproof painting decks are provided and water barrels and pails are placed at specified distances as prescribed by the Transport Commission's regulation.

When the forest supply was handy and plentiful, the timber was generally hand-hewn into ties and all wood used in the natural state. Utilization and fire depleted nearby supplies and wood preservation became a necessity, so that today it is considered sound practice to use treated ties, particularly in Class A track. This also applies to other exposed wood, such as piling and bridge stringers.

Forest fire prevention from the railway's viewpoint is a service it owes the people as well as a profitable activity. A quarter of a century ago men thought differently on this subject. Today the formation and work of a well-balanced committee by the National Fire Protection Association is a mark of progress.

Education, and there is room for still more, remains the greatest need in the larger aspects of forest conservation, including fire protection. Even now public administrators have a tendency to use the financial returns from the forest wealth for balancing budgets, and in so doing to starve the forestry departments, which are already restricted in what their expert knowledge tells them ought to be done.

The time is coming, if it is not already here, when there will be general emergency legislation to control, and if possible prevent, periodic outbreaks of fires from other than railway causes.

We are all apt to find regulations irksome, but the railways in Canada have long since recognized that the vision and judgment of the men who some thirty years ago laid the foundations of railway forest protection built wisely and profitably.

With others, the Canadian National Railways receives ample recompense in low fire losses and costs, and even more reward from the feeling that as good citizens they have individually and collectively made some contribution to national wealth and the well being of future generations of Canadians.

WHY FOREST PLANTATIONS FAIL

By PAUL O. RUDOLF
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An understanding of the causes of plantation failures is necessary if there is to be improvement in the large-scale reforestation work now underway in the Lake States. This paper presents an analysis of plantation mortality based on a resurvey of older plantations throughout the region and a special study made on the Huron National Forest to determine the effect of root placement and development on survival during 1936, a year of severe heat and drought.

IN RECENT years forest planting has become a major forest activity; it has been conducted upon a scale not previously approached. Especially is this true in the Lake States region.

With reforestation so much in the public eye, foresters are upon their mettle as never before to conduct their enterprise successfully. Obviously one of the best insurances for success is the ability to avoid failures, and to do so it is necessary to know the many causes of failure and their relative importance.

Upon the basis of such reasoning, the Lake States Forest Experiment Station has studied the causes of mortality upon large scale experimental plantations on the Huron National Forest for several years and in the fall of 1936 a special mortality study was made in the same locality following the very severe drought of that year.

Some Earlier Diagnoses

The many manuals and general planting instructions published, especially the earlier ones, are quite unanimous in emphasizing the necessity for protecting forest plantations from fire (*1*, *2*, *7*, *11*, and *13*). Quite commonly, too, they mention the necessity for protection from grazing. Some of them also point out that insects, fungi, and climatic factors may be responsible for plantation losses. These statements, however, are based on experience and general observation and not upon any specific diagnoses.

A general study of forest planting in the eastern United States made prior to 1915 (*11*) listed the causes of plantation loss as follows: insects; field mice and rabbits; wind, snow, and frost; grazing animals; fire; and diseases. A study of forest planting in southern Michigan made in 1919 (*17*) showed the chief factors of loss to be mice, rabbits, insects, and climatic factors (hail, sleet, frost, winter damage, and windfall).

Fire; drought; high temperatures; frost, snow, ice, and winter killing; animals (chiefly snow-shoe rabbits); insects; fungus diseases; poor stock and planting; and competition, were disclosed to be the principal causes of loss in a regional survey of forest planting conducted in the Lake States in 1924 and 1925 (*5*). A resurvey on the same area in 1935 and 1936 indicated that fire damage had become a minor factor of loss, due to improved protection; that drought and heat have caused more losses in the younger plantations, although the older ones have withstood them remarkably well; and that competition has become a more serious cause of loss among both older and younger plantations.

These studies, valuable as they are from the general standpoint, do not, and cannot, denote the relative importance of various mortality factors in any given locality under specific conditions.

The Locality

Before embarking upon any discussion of methodology or results it might be well to give a brief description of the locality in which these studies were made.

The Huron National Forest, located in Crawford, Iosco, Ogemaw, and Oscoda counties, Mich., was established in 1909 upon an area, essentially sand plains, which had been logged off and repeatedly burned over. Reforestation was established as a major activity early in its existence. Beginning in 1911, forest planting has been carried out yearly upon an increasing scale. Large plantations involving 10,000 acres annually were already being established here before the advent of the emergency programs in 1933. To date a net area of 90,000 acres has been planted on this forest. The soil is predominantly sandy and of low quality. The climate is comparatively severe. The normal annual rainfall is about 28 inches, and in extreme years there may be deficiencies up to 50

[1]Maintained in cooperation with University of Minnesota at University Farm, St. Paul, Minn.

percent. Maximum air temperature of 100° F. or over may be expected nearly every summer and winter temperatures may approach minus 40° F. Snowfall is comparatively light.

1936—A Severe Drought Year

Reports of the Weather Bureau provide a terse description of the severity of conditions during 1936. "July was characterized by extreme heat and drought. The month was marked by the hottest week on record in Michigan. . . . This was the driest July on record, and the fifth successive month with less than normal precipitation. . . . . August was also a hot month, though not noted for extreme temperatures as was July preceding. . . . Notwithstanding late rains, the crop season in 1936 was one of the driest ever experienced in Michigan. The total rainfall from May 1 to August 17 was only about 57 percent of the normal amount" (*16*).

Local conditions on the Huron National Forest can be described specifically on the basis of data obtained on four experimental blocks on that forest. Conditions became especially critical during July, when the following occurred: A maximum air temperature of 112° F. was recorded and the average maximum for the period July 7-13 was 104° F.; a minimum air temperature of 25° F. was also recorded; in one instance temperatures at the soil surface in the open, as recorded by a soil thermograph, exceeded 130° F. for eight and one-half consecutive hours and reached a maximum of 175° F.; at various localities there were from one to six days during which the soil surface temperature exceeded 130° F. for six consecutive hours; the soil moisture content diminished below the wilting coefficient for one to two weeks in several localities. The annual rainfall for this area was approximately 76 percent of normal while that for the three summer months (June, July, and August) averaged only 63 percent of normal.

These severe conditions indicate quite clearly the possibilities for plantation mortality due to climatic factors.

How the Study Was Made

This special study of plantation mortality[2] was made in the fall of 1936 in order to take advantage of the abundant clinical material available before disintegration made accurate diagnosis impossible. It was the object of the study first, to determine the effect of root placement and development upon survival during a severe year, second, to determine the relative importance of heat and drought in mortality during a severe "drought" year, and third, to find out if soil acidity, and percentage of fine material showed any relationship with survival.

The study involved twenty-six plantations on the Huron National Forest which ranged in planted age from one to eleven years (age of trees from seed ranged from two to thirteen years). Of the total number examined 15 were composed of red pine, 10 of jack pine, and one of white pine. These sampled the range of conditions which have been planted there fairly completely. The plantations studied had sufficient survival (usually thirty percent or better) so that comparisons between live and dead trees could be made on small plots.

In each plantation studied a sample of 200 trees systematically taken was examined. Each tree was excavated; classed according to condition; its height measured; its root system measured and classified as properly planted, slightly deformed or badly deformed, and as to whether or not it was predominantly in a single plane; the tree classified as to whether or not it was shaded, and if so by what species; and finally any cause of mortality or injury listed where it could be determined. In addition one living and one dead tree mechanically selected out of each group of 25 trees examined were excavated very carefully so as to remove the entire root system. Drawings were made to scale showing the position and dimensions of the furrow and the root development from three views: A bird's eye view showing the horizontal development, a view showing the vertical section in the direction of the slit,[3] and another similar view showing the development at right angles to the slit direction. At each point where these special trees were excavated soil samples were taken at depths of 2, 12, and 18 inches and their acidity and percentage of fine material determined.

The data were analyzed statistically, using Fishers' "z" test to determine the significance of

[2]Thanks are due to Junior Foresters Henry F. McCormick and MacAlister A. Schultz who were detailed to this study by the Huron National Forest and carried on the bulk of the field and computational work under the author's direction.

[3]All trees examined were planted in furrows by the slit method.

difference between several means and "Students" "t" test to compare pairs of means. By such methods there were tested the relationship between mortality and root form, between total height and root form, and between kind of cover and root form. The standard errors of the differences for each pair of means were computed.

In order to obtain a better method of comparing root development of dead and live trees and between plantations than is possible from the mere measurements of root extent, a method was devised for the mathematical analysis of the four-hundred drawings of root systems made in the study.[4]

What This Study Revealed

Factors affecting mortality.—An analysis was first made to show the relationship of root form and mortality. In the field, root systems had been classed in three groups, (1) those properly planted, (2) those slightly deformed, and (3) those badly deformed. Properly planted trees were those which had been correctly planted and had their roots extending straight down and fairly well spread out. Most of the deformed trees had roots which were looped or curled. Other causes of deformity were uncommon.

It was found that actual deformity, as yet, had little effect upon mortality, but there was some tendency in the case of red pine for a greater number of significant cases to occur in the older plantations. However, the one fact which stands out most strikingly in this analysis is the detrimental effect of cramped root systems on survival. Regardless of root class (properly planted, slightly deformed, or badly deformed) the trees with the bulk of their roots in a single plane showed greater mortality than those whose roots had spread out into the right angle plane. For jack pine there was 30 percent greater mortality in the single plane trees, and for red pine 18 percent. That this value is of some importance is evidenced by the fact that 62 percent of all the trees examined were classed as having their root system predominantly cramped into a single plane, despite the fact that they were planted in light sandy soil.

Analysis was also made to show the effects of cover on mortality. The trend was for highest mortality in open-grown trees, and lowest mortality under oak, with trees grown under jack pine, jack pine and oak, and other species intermediate. Although these data showed these particular differences to be significant in only five out of 25 plantations, the trend is probably correct since it follows the same form as that indicated by a previous study made in 1933 in which case these differences were significant.

When the data were combined so that the relationship between mortality, root form, and cover were considered in one analysis, it was found that the relationship was significant in all cases.

Factors affecting height growth.—In 21 out of 25 cases the relationship between root form and height growth was shown to be statistically significant. As in the case of mortality, the trees with roots cramped into a single plane showed poorer height growth than those which had better root spread. On the average the single-plane trees showed about a 20-percent reduction in height as compared with those of better root distribution.

The relationship between height growth, root form, and cover was significant in all cases. As a general statement, height growth is greater in open-grown trees and less under cover, and as has already been shown, it is greater for trees which have good root distribution than those which are cramped into a single plane.

Root Development of Dead and Live Trees

The development of the root system, as based on a combination of lateral spread, depth penetration, and density, on the average is greater for the live trees than for those which died during 1936. The relative development increases with age, as might be expected. The root development in the slit plane (the plane in which the trees were planted), quite logically is greater in all cases than that in the plane at right angles to the slit (See Table 1). Although the root systems of live trees average larger than those of dead trees the ratio of development in the two planes shows little differences as between live and dead trees until the oldest age-group is reached, in which the ratio for dead trees is nearly twice as great as for live trees. On the basis of total spread of root system the disparity between development in the right angle plane as compared to the slit plane is quite consistently smaller for the live trees than

[4]This method will be described in detail in a separate article.

the dead trees and decreases for both kinds of trees with increasing age (See Table 1).

Effects of soil factors.—The differences in acidity and percentage of fine material (at 2-, 12-, and 18-inch depths) of soil in which live trees grew and in which dead trees grew are very small, as may be seen in Table 1, and are of no significance, statistically. As a matter of fact, these factors (soil acidity and colloidal content) are remarkably uniform throughout the twenty-six plantations studied. On the basis of this study it is apparent that such slight differences as there are, have no influence on mortality.

Causes of mortality.—As was stated at the outset, one of the objectives of this study was to determine the actual causes of mortality for each tree which died. An attempt was made to differentiate between heat and drought damage which, although not perfect, is believed to have been quite accurate. In all cases where trees were found in which the cambium had been killed in a zone usually within 2 inches of the soil level, it was classed as heat damage. In other cases where the causes of death was evidently physiological but there was no evidence of heat damage, the trees were classed as drought-killed. A few other causes such as grubs, trampling, etc., which were quite easy to distinguish, were also included, but, as shown in Table 1, these factors of loss were almost entirely absent during the 1936 season. Table 1 indicates a regular trend for decreasing heat mortality with increasing age of stand. In the youngest age groups, the proportion of the total mortality due to heat is nearly 80 percent, while with the oldest plantations, that is, the 10-13-year old group, the proportion of heat damage has dropped to approximately 50 percent. In all cases the balance of the loss is almost entirely due to drought, with other factors playing an insignificant part. It is evident from this result that heat is a factor of major importance in causing plantation loss in a year such as 1936, and it is quite probable that much of the loss classed as drought loss in past years was in part due to heat.

The surprising thing is that heat played such an important role in the mortality of plantations up to 13 years in age. In addition to the trees which were actually killed by heat, there were quite a few in the old age groups, classed as living, which had actually been injured by heat, as evidenced by lesions near the ground line, usually on the south, southwest, or west sides of the stem. It is possible that this injury, which has not been sufficiently severe to cause death in the present year, may lead to the eventual death or serious injury in later years.

Some Practical Applications

The results of this study illuminate certain weaknesses in our planting practice under the conditions peculiar to the lower Michigan sand plains, chiefly as concerns method of planting, class of stock, and species. It is quite likely too, that they are applicable throughout the Lake States under sand plains conditions.

This study has shown rather conclusively that young red and jack pine trees which have their root systems predominantly cramped into a single plane suffer a significant decrease both in survival and height growth as compared to those trees which have more uniform root de-

Table 1.—Relation of Mortality to Root Development, Soil Acidity, and Percentage of Fine Material in the Soil

Species	Age	—Average root extent— Depth	Lateral spread Slit dir.	Rt./s to slit	Ave. pH. values 2 inches	12 inches	18 inches	Ave. percent fine material 2 inches	12 inches	18 inches	Causes of death or injury Percent Heat	Drought	Others
		Inches	*Inches*	*Inches*									
						Live trees							
JP 1-0	2	8.4	4.3	2.3	5.5	5.6	5.8	8.9	10.0	9.6	—	100	—
"	3	9.3	7.2	3.6	5.4	5.6	5.8	9.4	10.3	10.0	—	—	—
NP 2-0	3-6	11.5	12.2	8.0	5.4	5.6	5.6	8.9	9.3	9.1	100	—	—
"	7-8	16.8	50.3	39.1	5.3	5.5	5.6	9.1	9.1	9.6	100	—	—
"	10-13	17.1	81.0	62.9	5.1	5.5	5.5	9.3	9.6	9.3	100	..	..
						Dead trees							
JP 1-0	2	6.0	2.7	1.3	5.6	5.7	5.9	8.6	9.9	9.4	77	22	1
"	3	7.6	5.7	3.0	5.7	5.6	5.7	9.2	9.9	10.3	70	28	2
NP 2-0	3-6	7.7	5.1	2.8	5.5	5.6	5.6	9.0	9.6	9.4	67	33	...
"	7-8	12.2	25.3	15.2	5.3	5.5	5.5	9.1	9.6	9.2	59	41	—
"	10-13	12.8	51.3	32.2	5.1	5.5	5.6	9.8	9.7	9.3	53	44	3

velopment. This fact seems to be somewhat of an indictment of the slit method of planting which starts the trees out with their entire root systems in a single plane and adds to their struggle for existence against climatic and edaphic factors the burden of laboriously developing a new root system of more uniform distribution. True enough some of the trees planted by the slit method do seem to overcome this effect, but according to this study less than 30 percent of the trees can be placed in that category.

The fact that deformities other than cramping into a single plane showed no detrimental effects may be of temporary encouragement only, since it was found that Scotch pine plantations in the province of Norrland in Sweden (*15*) actually showed greater stem diameter for trees with deformed root systems than those with sound root systems, but after 15 years in age the former began to show inordinately high mortality.

The obvious recommendation is either the use of stock which is not so affected by slit-planting or the use of a method which gives the root system better distribution at the outset.

German and Russian investigations (*6, 15*) long ago proved that the adaptability of pine root systems is greatest at a very early stage. Purely from the standpoint of flexibility of root system, then, 1-0 stock is superior to any older stock. The Germans early attempted to make large stock less susceptible to root-cramping by clipping all lateral roots to a length of about one inch. This system was successful in the object, but made it necessary to provide artificial watering for stock so treated and hence made the method impractical for field planting.

It has already been proven that because of its poor resistance chiefly to heat, drought, and smothering damage, 1-0 red pine stock is not suitable for planting under the conditions prevailing on the Huron National Forest. With somewhat less emphasis the same can be said for 1-0 jack pine, although it is believed that there is some possibility that suitable 1-0 stock of this species might be developed by special nursery practices.

Since the use of 1-0 stock in this locality can, for all practical purposes, be considered "out," the other alternative, the use of larger stock with a method of planting providing good root distribution should be given due weight. Unfortunately, while the Huron National Forest abounds with examples of the slit method of planting, there are very few examples of other methods of planting to provide valid comparisons. Some of the very oldest plantations (1911-1913) were established by the hole method but they were too few in number and too meager in area to afford any real comparison with the large areas of slit planting established at a later date and under slightly different conditions. On the other hand, the Experiment Station has carried on some wedge[5] planting since 1933 and the Huron National Forest has also done some such planting since 1934, but these plantations are too young to show the real effects of this system of planting in comparison with the slit method.

Despite such lack of comparison on the Huron National Forest itself, the results of a study of older plantations in Michigan showed that at the average age of twenty-two years those plantations established by the hole method had 26 percent greater survival than those planted by the slit method in furrows. It is quite to be expected too that rather than decrease or even remain constant this difference will widen out between thirty and forty years while the planted trees are coming into intense competition with each other and establishing a true stand.

The large proportion of mortality due to heat as shown by this study makes it desirable that measures be taken to prevent such damage. Although it might be stated truthfully that many of the trees killed by heat during 1936 would have succumbed to drought anyhow before the summer was over, this does not alter the fact that much heat loss could be prevented by the use of practices which are already known. The point might also be raised, and quite aptly, that such conditions as were extant during the summer of 1936 are not likely to recur very frequently. However, even though such severe conditions are infrequent, data collected since 1933 show that soil surface temperatures which may be lethal for plants the equivalent of 2-2 red pine stock occur to some extent every summer. Protective

[5]By this method a hole is dug so as to leave a wedge, or inverted-vee shaped mound in the center. The tree is then planted so that the roots are distributed on both sides of the mound.

measures are therefor in order.

Heat losses may be cut down first by the use of stock larger and sturdier than the seedling stock which has been so commonly used. But even the largest stock feasible for planting may suffer some heat loss in the stark open. Therefore, shading should be used to reduce surface soil temperatures.

Advantage may be taken of natural cover by planting trees to the north and east sides (so they are shaded from the south and west) of existing trees and shrubs. This study shows, and it is supported by one made in 1933, that better survival and growth may be expected of red pine planted under oak than under jack pine.

If planting is done in the open, shade should perhaps be provided artificially. Each tree may be shaded by a shingle placed to the southwest as has been done in Europe, or brush can be cut and placed so as to protect the trees. The latter method has been used with success on plantings made by the Lake States Experiment Station in North Dakota. In this connection also, there is a possibility that unusually hardy trees and shrubs (such as Caragana, Russian olive, etc.) could be established in openings and then after they have attained sufficient size to afford protection, they could be interspersed with planted pines. This idea needs trial. Scotch pine, however, on the Huron National Forest has actually shown enough better resistance to drought and heat as compared to red pine and even jack pine to warrant its use as a nurse crop for red and jack pines.

Summary

Planting has become a major forest activity and much of the public reaction toward forestry depends upon success in this field. One of the requirements for success is the ability to avoid failures; from which it follows that a knowledge of the relative importance of various factors causing plantation losses is of practical value. Various planting manuals and general studies list principal causes of plantation mortality but they are of general value only.

A study conducted by the Lake States Forest Experiment Station on the Huron National Forest in lower Michigan in the fall of 1936 after the severe drought of that year disclosed that planted trees with roots predominantly in a single plane had significantly greater mortality and poorer height growth than those with better root distribution, that heat and drought accounted for most of the mortality, with heat playing a major role, and that neither soil acidity nor percentage of fine material showed any significant relationship to survival.

Such plantation mortality could be reduced by practices already known.

Literature Cited

1. Barnard, W. D. 1916. Forest planting in Wisconsin. Wis. Conserv. Comn. Bull. 1.
2. Claridge, F. H. 1926. Forest tree planting. N. C. Dept. Conserv. and Development. Circ. 15.
3. Clothier, G. L. 1905. Forest planting and farm management. U. S. Dept. of Agric. Farmers' Bull. 228.
4. Eyre, F. H. 1933. Aspen competition in Norway pine plantations. Jour. Forestry 31:318-321.
5. Kittredge, J., Jr. 1929. Forest planting in the Lake States. U. S. Dept. Agric. Bull. 1497.
6. Kobranov, N. P. 1930. Obsledovanie i issledovanie lesnikh kultur (Examination and analysis of forest plantations). State Exp. Inst. Forest Mgt. and Wood Industries. Trans. For. Research 8:1-102. Leningrad.
7. Richardson, A. H. 1924. Forest tree planting. Ontario Dept. of Lands and Forests, Bull. 1.
8. Rudolf, P. O. 1935. History of forest planting in the Lake States. Minn. Conservationist Oct. 1935; 12-24.
9. — ———. 1937. Lessons from past forest planting in the Lake States. Jour. Forestry 35:72-76.
10. Spring, S. N. 1906. Forest planting on coal lands in western Pennsylvania. U. S. Dept. Agric. For. Serv. Circ. 41.
11. Tillotson, C. R. 1915. Forest planting in the eastern United States. U. S. Dept. Agric. Bull. 153.
12. Trenk, F. B. 1932. Forest planting handbook. Wisconsin Conserv. Dept.

13. Wakeley, P. C. 1929. Planting southern pine. U. S. Dept. Agric. Leaflet 32.
14. Ware, E. R. 1936. Planting and care of trees in South Dakota. S. Dak. State Coll. Extension Circ. 356.
15. Wibeck, E. 1923. Om missbildning av tallens rotsystem vid spettplantering (The deformity of pine root system as caused by bar-planting). Meddelanden fran statens Skogsforsoksanstalt 20:261-303.
16. Wills, H. M. 1936. Climatological data, Michigan Section. U. S. Dept. Agric. Weather Bur. Annual Summary 51(13): 49-54.
17. Young, L. J. 1921. Forest planting in southern Michigan. Jour. Forestry 19:1-8.

MORTALITY IN CUTOVER STANDS OF PONDEROSA PINE

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Mortality of ponderosa pine in the Southwest has been studied for almost 30 years. It has been found that the most important agencies responsible for the death of trees are wind, lightning, mistletoe, and insects. As might be expected, the rate of mortality appears to be highest in trees of the largest diameter. After the trees reach a diameter of about 23 inches there is a comparatively rapid increase in mortality rate and on cutover areas the average annual loss of trees 30 inches and over in diameter is about 1 percent. Thus, if appreciable returns are to be realized from large trees, continual salvage operations are called for.

MORTALITY is one of the big question marks in predicting yield. In establishing tree records in the Southwest 25 to 30 years ago, mortality was one of several considerations that influenced the decision to supplement the usual type of small plots with "extensive" plots several hundred acres in size.

Mortality on Growth Plots

Table 1 shows the extent of losses in relation to volume, increment, and character of the reserved stand on the largest plots maintained by the Southwestern Forest and Range Experiment Station. More detailed descriptions of the first six plots are given in a recent article by Krauch[2] who also discusses several phases of the mortality question. In general the actual volume of loss rises but the percent of loss declines as the volume of the reserved stand increases. The rate of mortality also appears to be highest in stands of largest average diameter. The last two plots have been added because, although the records cover only 10 years, they provide a comparison of a cutover and an uncut area side by side. It may be seen that, notwithstanding a slight advantage in gross increment, mortality reduces the net increment of the uncut plot 27 percent below that of the cutover plot.

Cutover Plots S3, S4, and S5 provide the desired combination of long record and large acreage. The relatively low mortality on S4 may be explained in part by the absence of mistletoe and in part by the small amount of windfall. Absence of mistletoe may be accidental but is thought to be related to climatic influences. Light windfall is probably explained by the fact that the remaining large trees are mainly open-grown and of low height in proportion to their diameter. A low height-diameter ratio is characteristic of the site. Another contributing factor is the presence of deep layers of volcanic cinders which would tend to prevent the water-logged conditions that are conducive to windthrow in the early spring. This plot is typical of but a small portion of the pine area on the Colorado Plateau. On the other hand, it does suggest the possibility that the other two plots, S3 and S5, may present too dark a picture of mortality for the Southwest as a whole.

The only available records of pine mortality in other sections of the Southwest are furnished by 10 small plots on early Forest Service cuttings. Mortality is expressed in per-

[1]Maintained at Tucson, Ariz., by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of Arizona, and covering the states of Arizona, New Mexico, and the western third of Texas.

[2]Krauch, H. Growth and yield of cutover stands of ponderosa pine in Arizona under different methods of cutting. Jour. Forestry 35: 1134-1147. 1937.

cent of original volume, board measure, of trees 11.6 inches d.b.h. and over at the first measurement. The losses were:

Santa Fe, five plots of 6 acres each, record 25 years, mean annual mortality 0.89, 0.80, 0.72, 0.58, and 0.13 percent.

Datil (Gila), three plots of 6, 6, and 14 acres, record 25 years, mean annual mortality 1.84, 1.77, and 0.87 percent.

Gila, two plots of 6.0 and 6.4 acres, record 20 years, mean annual mortality 0.71 and 0.00 percent.

Small plots usually give erratic figures on mortality. A long period tends to correct this fault. Seven of the ten plots lost more than 0.70 percent of the original volume annually. Records of larger areas are obviously desirable. Since it has been standard Forest Service practice during the past 25 years to fell all snags immediately after cutting, it would seem feasible to make extensive mortality surveys.

Mortality in Different Diameter Classes

In timber management the question that is being asked about mortality is "what classes of trees are most likely to die after cutting, and what can be done to lower these losses." Assuming that defective and declining trees are removed in cutting, there may still be a wide variation in susceptibility to killing agents. Observations point to a relation between mortality and size. Previous compilations of sample plot records have shown what proportion of the total loss falls in different diameter classes, but they have not shown the relation of the loss in each diameter class to the original number or volume of that class. The difference between the two sets of figures is obvious. If the reserved stand is made up of diameter classes ranging from 12 to 36 inches, the timber marker wants to know for each class what the chances are of survival until the next cut. The compilations presented in the following pages attempt to answer this question.

Table 2 shows the total mortality and also the mortality within each broad diameter class in relation to the number of trees and volume in that class at the beginning of the record. On all of the cutover plots the first measurement followed within a year after logging. Plots S3, S4, and S5 in Table 2 are not quite identical with plots of the same designation in Table 1, because in Table 1 the so-called "intensive" plots within the main plot are excluded while in Table 2 they are included. Table 2 also combines Plots S5 I, S5 II, and S5 III in order to obtain large numbers of trees for purposes of classification.

In order to express mortality as a percentage of the respective diameter classes to which the trees that died belonged at the time of cutting, it is necessary to know the original diameter of each tree as well as the original number and volume of trees in its class. This information is directly available for Plots S5, S6, and S7 because each tree was tagged and recorded separately when the plot was established. On Plots S3 and S4, however, only the "intensive" plots, comprising 5 percent of the total area, were tagged at the outset; the trees on the "extensive" portion of the plots were tallied by 1-inch classes but were not tagged and recorded individually until 1924. In order to place all the plots on a comparable basis, the dead trees on Plots S3 and S4 have been reduced to their original diameter class by making allowance for growth up to the time of death. The average amount of this growth was determined from the record of dead trees on the intensive plots and the recorded growth of trees that died on the extensive plot after 1924. An interesting dis-

Table 1.—Increment and Mortality on Sample Plots on the Coconino and Kaibab National Forests. Record Includes Only Trees 11.6 Inches d.b.h. and Over When Plots Were Established

Plot designation	Method of cutting	Record	Area of plot	Residual stand: Trees per acre	Average d.b.h.	Volume per acre	Mean annual increment per acre board measure: Gross		Net		Mean annual mortality per acre in volume board measure	
		Yrs.	*Acres*	*No.*	*In.*	*Ft. b.m.*	*Ft.*	*Percent*	*Ft.*	*Percent*	*Ft.*	*Percent*
S3	Group selection	25	456	11.7	19.6	3520	105	2.98	86	2.44	19	0.54
S4	Group selection	25	304	9.4	19.0	2328	73	3.13	65	2.79	8	0.34
S5 I	Group selection	20	139	12.1	18.5	2846	97	3.41	79	2.78	18	0.63
S5 II	Scattered seed tree	20	152	3.9	22.7	1873	53	2.83	32	1.71	21	1.12
S5 III	Light selection	20	112	13.7	19.8	4510	122	2.71	90	2.00	32	0.71
S6	Virgin	10	160	19.5	23.1	11778	116	0.98	72	0.61	44	0.37
S7	Group selection	10	160	14.0	18.1	3423	110	3.21	99	2.89	11	0.32

covery in connection with this computation was that a large proportion of the dead trees had made very little growth during a decade or more preceding death. This was especially true of trees killed by mistletoe and trees which succumbed slowly to the effects of lightning.

It is evident from the records of Plots S3, S4, and S5 in Table 2 that mortality is much higher in diameters above 30 inches than below that size. In Plot S3, the group of diameter classes above 30 inches has lost nearly three times as much volume as the 21- to 30-inch group; in Plot S5 the ratio is more than two to one; in Plot S4 the contrast is not so great but is indicative of a similar trend. This is true, also, of the 10-year record in Plot S7. Figure 1, which is a graphic representation of losses on Plot S5 by 1-inch classes, indicates that a sharp upward trend begins well below the 30-inch class, being first evident at 23 inches.

If sample Plots S3 and S5 are at all representative of the Colorado Plateau—and it must be admitted that they are more so than sample Plot S4—it means that an annual loss of over 1 percent is to be expected in diameter classes above 30 inches on cutover areas. Since the gross increment of these classes is usually less than 1.5 per cent, it follows that the margin left as net increment is likely to be narrow. This means that realization of appreciable returns from large trees calls for continuous salvage operations, and that a growing stock made up of large, mature trees is likely to be short lived. On the other hand, if extensive areas are found to have a mortality rate as low as that of Plot S4 the picture assumes a brighter aspect.

The Causes of Mortality

Agencies responsible for the death of trees in Table 3 are, in order of importance, wind and lightning (about equal), mistletoe, and insects (mainly bark beetles). The caption "Unclassified" includes trees the cause of whose death could not be determined by the recorder. It is likely that insects are a major

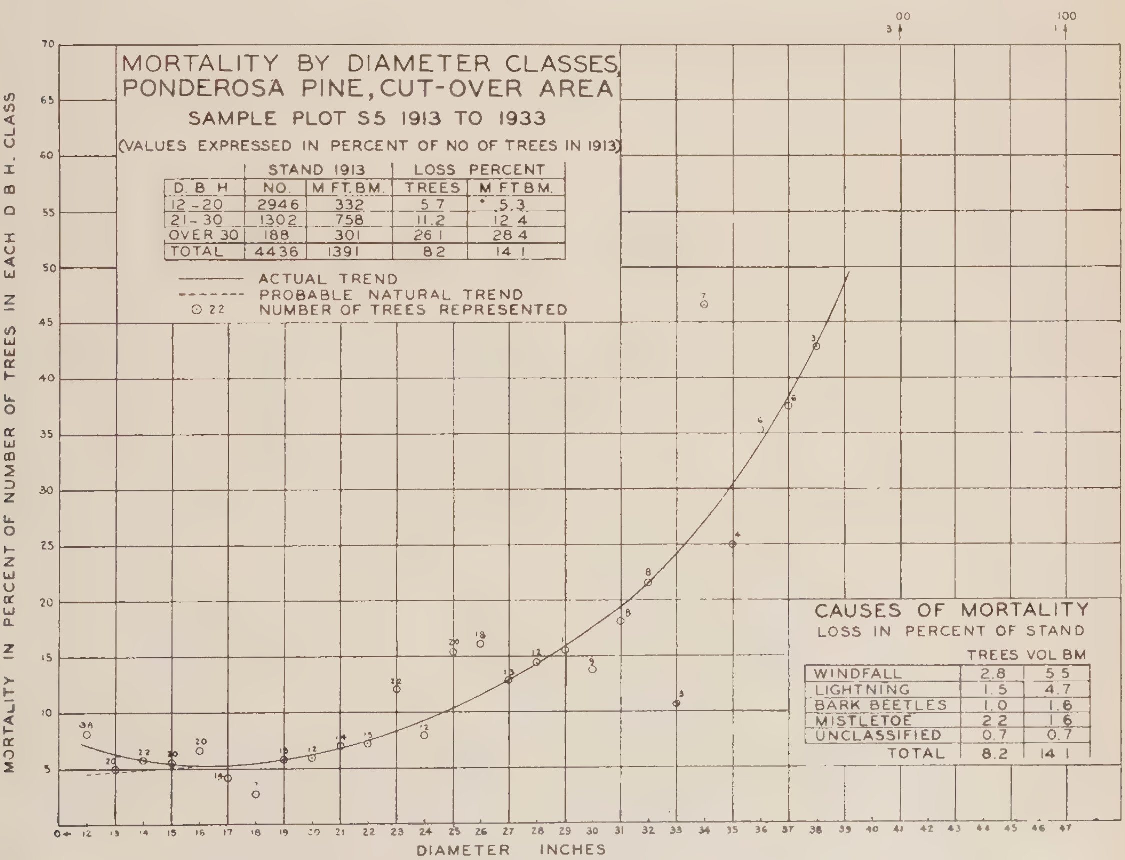

Fig. 1.—Graphic representation of losses on Plot S5 by 1-inch classes.

contributing factor. The relative order varies from plot to plot. Mistletoe is high on most of the areas but does not occur on Plot S4. Wind and lightning take their greatest toll from large trees, whereas mistletoe is most active in the lower diameter classes and shows up more in numbers killed than in the volume of loss. The upswing at the lower end of the graph in Figure 1 is attributed to mistletoe. Tall trees are generally considered most susceptible to wind and lightning, but this opinion has not been verified by measurements except as it is known that height increases more or less directly with diameter.

Lightning is not always immediately fatal; in fact, many young trees recover unless attacked by bark beetles. Old trees may linger several decades and finally succumb as a direct consequence of bark beetles. Instances have been observed in which lightning has struck the same tree several times. On sample Plot S4. 27 trees were killed by lightning in 25 years and 26 additional ones were struck but are still surviving. On sample Plot S7 only 16 trees were killed by lightning in 10 years, but 26 additional ones were struck during the same period. Many lightning-scarred trees, though recorded as living, are clearly declining or have suffered deterioration in quality. These observations suggest that the effects of lightning may be cumulative over a long period of years.

Bearing on Forest Management

The available records indicate that mortality is an important factor in yield. Analysis by 5-year periods shows no consistent relation between mortality and time elapsed since cutting. Records on several plots are consistent in pointing to large trees as by far the poorest

Table 2.—Mortality in Relation to Size of Trees. In each of the Three Broad Diameter Classes, the Percentage of Loss is Based on Total Number of Trees or Board-foot Volume in That Class at the Beginning of the Record

Diameter class	Stand after cutting: Total Trees	Total Volume	Per acre Trees	Per acre Volume	Mortality: For period Trees	For period Volume	Annual Trees	Annual Volume
Inches	*Number*	*M ft. b.m.*	*Number*	*Ft. b.m.*	*Number*	*Ft. b.m.*	*Percent*	*Percent*
Sample Plot S3, 480 acres, logged 1909, record 25 years								
12-20	3825	529	7.97	1102	348	47836	0.36	0.36
21-30	1775	940	3.70	1959	167	99229	0.38	0.42
31-43	158	231	0.33	481	46	67764	1.16	1.17
Total	5758	1700	12.00	3542	561	214829	0.39	0.50
Sample Plot S4, 320 acres, logged 1909, record 25 years								
12-20	2233	272	6.98	850	100	11838	0.18	0.18
21-30	757	368	2.36	1150	60	32460	0.32	0.35
31-44	92	122	0.29	381	11	14030	0.48	0.46
Total	3082	762	9.63	2381	171	58328	0.21[1]	0.31[1]
Sample Plot S5, 455 acres, logged 1913, record 20 years								
12-20	2946	332	6.48	730	168	17596	0.28	0.26
21-30	1302	758	2.86	1666	146	93596	0.56	0.62
31-47	188	301	0.41	661	49	85701	1.30	1.42
Total	4436	1391	9.75	3057	363	196893	0.41	0.70
Sample Plot S7, 160 acres, logged 1924, record 10 years								
12-20	1713	218	10.71	1363	16	2320	0.09	0.11
21-30	511	296	3.19	1850	20	13990	0.39	0.47
31-38	21	34	0.13	212	1	2280	0.48	0.67
Total	2245	548	14.03	3425	37	18590	0.16	0.34
Sample Plot S6, 160 acres, virgin stand, record 10 years								
12-20	1361	216	8.51	1350	17	2970	0.13	0.14
21-30	1402	1017	8.76	6356	36	29330	0.26	0.29
31-48	356	651	2.22	4069	22	38670	0.61	0.59
Total	3119	1884	19.49	11775	75	70970	0.24	0.38

[1]Trees cut in trespass omitted.

risk. No forester can advocate leaving large volumes of big trees if they are going to be lost. One solution is to remove them in the first cutting unless needed for seed production; another is to plan frequent salvage operations, taking out dead and dying trees before they deteriorate. What should be done on a given area depends on the character of the stand, local conditions, and objects of management. This paper is concerned only with the facts about mortality, and does not offer a practical solution of the problem.

TABLE 3.—MORTALITY CLASSIFIED BY CAUSES AND DIAMETER OF TREES. IN EACH OF THE THREE BROAD DIAMETER CLASSES THE PERCENTAGE OF LOSS ATTRIBUTED TO EACH KILLING AGENCY IS BASED ON THE NUMBER OF TREES OR BOARD-FOOT VOLUME IN THAT CLASS AT THE BEGINNING OF THE RECORD

D.b.h. class	Percent of number and volume b.m. killed by different agencies[1]									
	Wind		Lightning		Insects		Mistletoe		Unclassified	
	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume
Inches										
Sample Plot S3, 480 acres, record 1909-1934, 25 years										
12-20	1.2	1.4	0.6	0.9	0.5	0.4	5.7	5.1	1.1	1.2
21-30	2.7	3.3	2.8	3.2	0.5	0.6	3.0	3.0	0.4	0.5
31-43	12.0	11.8	10.8	11.5	1.3	1.2	4.4	4.2	0.6	0.6
Total	2.0	3.9	1.5	3.6	0.5	0.6	4.8	3.8	0.9	0.7
Percent of total dead	20.3	30.9	16.0	28.5	5.2	4.8	49.2	30.0	9.3	5.8
Sample Plot S4, 320 acres, record 1909-1934, 25 years										
12-20	1.1	1.1	0.3	0.3	1.2	1.1	0.0	0.0	1.1	1.0
21-30	2.4	2.3	2.2	2.9	1.6	1.7	0.0	0.0	1.6	1.6
31-44	2.2	2.0	4.4	4.6	0.0	0.0	0.0	0.0	5.4	5.0
Total	1.5	1.8	0.9	2.2	1.3	1.2	0.0	0.0	1.3	1.9
Percent of total dead	26.3	24.2	15.8	29.2	23.4	16.0	0.0	0.0	24.0	25.3
Sample Plot S5, 455 acres, record 1913-1933, 20 years										
12-20	1.2	1.4	0.4	0.6	0.7	0.6	2.7	2.0	0.7	0.7
21-30	5.4	5.7	2.5	3.2	1.5	1.9	0.9	0.8	0.9	0.8
31-47	9.1	9.3	11.7	13.2	2.1	2.1	2.7	3.2	0.5	0.6
Total	2.8	5.5	1.5	4.7	1.0	1.6	2.2	1.6	0.7	0.7
Percent of total dead	33.9	38.7	18.5	33.4	11.8	11.4	26.7	11.5	9.1	5.0
Sample Plot S7, 168 acres, record 1925-1935, 10 years										
12-20	0.1	0.1	0.2	0.3	0.1	0.1	0.4	0.5	0.1	0.0
21-30	0.4	0.6	2.5	3.0	0.8	1.0	0.0	0.0	0.2	0.2
31-38	4.8	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	0.7	0.7	1.7	0.2	0.6	0.3	0.2	0.1	0.2
Percent of total dead	13.5	21.8	43.3	50.2	13.5	17.0	18.9	5.6	5.4	4.6
Sample Plot S6, virgin stand, 160 acres, record 1925-1935, 10 years										
12-20	0.2	0.3	0.2	0.3	0.4	0.4	0.3	0.3	0.0	0.0
21-30	0.6	0.7	0.7	0.9	1.1	1.2	0.1	0.1	0.0	0.0
31-48	1.1	1.0	2.2	2.4	2.2	2.0	0.3	0.2	0.3	0.3
Total	0.5	0.8	0.7	1.4	0.9	1.4	0.2	0.2	0.0	0.1
Percent of total dead	21.4	20.2	28.0	36.2	38.7	35.8	8.0	4.4	1.3	3.2

[1]Excludes small loses by fire and suppression.

MAGAZINE WRITING FOR FORESTERS

By HENRY E. CLEPPER

Society of American Foresters

Numerous periodical publications are open to the forester who wishes to contribute articles on his professional work and interests. The author's conclusions are based on some fifteen years of experience in part-time writing about forestry for magazines and newspapers. Since it has been largely an avocation, he makes no claim to expert knowledge of the art. But the young forestry-writer may find the suggestions helpful in his efforts in this interesting field.

ALMOST every forester with deep interest in his professional work occasionally feels the urge to write about things that have engaged his attention. Perhaps he is a nurseryman who has perfected a new transplanting board, and wants to tell other nurserymen about it. If he is a silviculturist who has spent several years studying the beech-birch-maple type, he will eventually want to publish the results of his research. The extension forester, for example, may want to outline a profitable method of managing farm woodlands. Or, let us say, he is in white pine blister rust control in the Lake States and has discovered a new Ribes-eradicating technique. He will want to describe it so that it can be tried out in New England.

If a rare range plant, an unusual example of tree growth, a new timber-cutting method, or an adventure on the fire line attracts the forester, he will usally desire to share his information with others. In short, he will want to write about it.

But writing the article and getting it published are two different things. If it is a technical article on silviculture it suggests the JOURNAL OF FORESTRY. If it describes a new species of plant it suggests the *Journal of Botany*. If it is a popular article on conservation with national appeal it suggests *American Forests*. If it is descriptive of a new logging method it suggests *The Timberman*. If it concerns animals it suggests *Nature Magazine*. And if it tells how to manage farm woodlands for profit it suggests *American Agriculturist*.

Consequently, if a forester has something interesting to write about, and if his article is logically thought out and well written, he can usually find a periodical to publish it. Sometimes foresters, particularly young foresters, complain that no magazine apparently wants to print the articles they have written. Often they believe their manuscripts are rejected because they are unknown, because they do not have established reputations. Such is rarely, if ever, the case.

Usually one of two things is wrong. Either the article is poorly written, in which case an editor cannot be expected to accept it; or, if well written, the author sent it to the wrong market.

Field and Stream might not be interested in the paper "Liberation Cutting in Relation to the Deer-Carrying Capacity of the Oak-Chestnut Type," but the *Journal of Wildlife Management* might accept it. Similarly, "The Structure of Wood and its Penetrability" if not acceptable to *American Forests* may be well suited (and was) to the *Paper Trade Journal*. These examples could be prolonged indefinitely. The point is that the forester who has written an article and wishes to see it in print must know more than the subject written about. He should also know something about the business of marketing his wares.

Most foresters are not professional writers. If they were, they would not be foresters. Moreover, they are usually not well informed of the available outlets for their writing. As a matter of fact, they can hardly be expected to have such information unless they have made a study of the magazine publishing business, which few have the time or facilities to do. To supply this information, and to help those forestry-writers who seek outlets for their writing, is the reason this article was written.

The present writer, unfortunately, cannot teach prospective writers how to write. Neither can he define what is an acceptable article, and what is not. But he has written a goodly number himself, and, if his experience in writing for periodicals will be of assistance to other foresters, he is glad to make it available. Let it be understood, however, that he does not set himself up as an expert.

The forestry-writer is a specialist. Unless he is as versatile as a Tom Gill or an Aldo Leopold (which most of us, unfortunately, are not), he confines his writing strictly to his profession. In most cases he confines it to some specialized field

of forestry. Paradoxically enough, some editors say that the specialist "makes the ideal contributor of magazine articles."

The forester who has made wildlife management or economics or fire control his own province has no trouble holding the reader's attention as long as he avoids becoming too technical. Two things the average reader seeks: instruction and entertainment. Consequently, he expects an article to be authoritative, reasonably understandable, and clearly written. Other qualities are demanded of writers in literary magazines or in magazines of general circulation, but we are now concerned with those periodicals only to which forestry-writers usually contribute. But foresters who delight in veiling their meaning with obscure technical terminology, and those who clothe the simplest statements in ponderous scientific dress, seldom attain popularity as writers however eminent they may otherwise become. The specialist who reaches the largest audience and who, therefore, exercises the greatest influence is the one who, when he writes, keeps his readers in mind.

To tell the truth, the genuine expert customarily writes simply, clearly, and forcibly. It is the superficial expert who stumbles into the pitfall of "too much learning." One time the present writer was asked to review a paper written by a young forester newly out of college, who proposed to discuss the methods by which the public could be educated in forest fire prevention. Nothing whatever was wrong with his general thesis, excepting that he wholly lacked experience in the field he was writing about. His inexperience was revealed by his misuse of the technical terminology of fire control. A fire control expert would quickly have recognized the article for what it was, an amateurish attempt to pose as an expert.

How can the forestry-writer get his articles published? In one of two ways: Either write the article with a definite magazine in mind; or, after it is written, submit it to the magazine or magazines to whose editorial policy, contents, and general circulation the article is adapted.

The mechanics of submitting an article to a magazine are simple. It should be carefully and legibly typewritten, double-spaced, with the author's name and address at the top of the first page. Enclosed with it should be a stamped envelope for its return in case it is rejected. One or two, or even more, rejections do not mean that the article necessarily lacks merit.

For example, some time ago the present writer became interested in the important role played by wood in the pageant of American transportation. In his spare time he wrote a brief article on the old wooden water trough. Although the wooden water trough has almost passed out of existence, he wished to show how, in an earlier era of our history, it was quite as indispensable an object of public utility as the modern filling station is in this age. When finished the article was submitted to *American Forests,* but was rejected because it treated of a form of wood utilization that is no longer of economic importance. It was then sent to the *National Historical Magazine* whose editor accepted it because of its historical background.

But lest it be assumed that all articles are so quickly disposed of, another example of an opposite extreme may be in order. Once the present writer wrote a popular article on forest fire fighting. The manuscript made the rounds of twelve editorial offices before the author was convinced that something was fundamentally wrong with it. He then rewrote it, cut it to half its former length, and placed it on the first trial in the Sunday feature section of the Philadelphia *Public Ledger.*

Prospective forestry-writers occasionally ask how they can prepare acceptable technical articles. There is no secret about it. The method has been succinctly stated by Dr. Henry Schmitz, editor-in-chief of the JOURNAL OF FORESTRY. "Only three things are necessary to write an acceptable scientific or technical article. Firstly, the writer must have some facts or ideas, or both, on a definite subject. Secondly, he must be able, through the use of words, to convey clearly these facts or ideas to others. Thirdly, the author must conform to the conventional form of presentation required by the particular scientific journal in which it is to be published."

The quotation is from the style manual[1] for the JOURNAL OF FORESTRY published by the Society of American Foresters. The manual may be obtained free by members upon request from the Society's executive office.

Another question often asked is, "On what basis are articles accepted by the JOURNAL OF FORESTRY?" A manuscript, let us say, on a new technique of fire control in chaparral is received in the editorial office in Washington. It is recorded and forwarded to the editor-in-chief. He reads it for general content and decides whether

[1]Clepper, H. E. Suggestions for contributors to the JOURNAL OF FORESTRY. Soc. Amer. Foresters, Washington, D. C. 1938.

it is written in conformity with JOURNAL procedure. If he finds that it appears to be suitable, he sends it to the associate editor in charge of "forest protection and administration," who in turn carefully scrutinizes it for its technical qualities. Should the paper deal with a field in which the associate editor is not fully informed or with a region in which he has not had personal experience, he may refer the manuscript to another authority or suggest that the editor-in-chief do so. Then, should the article prove to be technically acceptable, it will be edited with care by the editor-in-chief to eliminate errors in grammar, spelling, punctuation, and factual statements. He will make suggestions to the author for rewriting if necessary, and decide upon the use of any illustrations or graphs which may have been submitted.

The manuscript, approved for publication, then goes to the managing editor's office where all literature citations and tables are again verified. The managing editor reads it carefully at least once to make sure that all details conform to JOURNAL standards. It is then sent to the printer who sets it in type. A galley proof is mailed to the author with the request that he check it for factual and typographical errors. When the galley proof is returned, it is painstakingly proofread in the editorial office and compared with the edited manuscript. The galley proof is next set in page proof, which is once more carefully proofread. The corrected page proof is returned to the printer, and the article is finally ready to appear.

Thus an article published in the JOURNAL OF FORESTRY has been editorially read by a least three persons, perhaps more, and has been carefully proofread by two others, before it reaches the profession at large.

Most professional writers write for money. That is why they are professionals. The scientific writer may write for money, but usually he writes for another reason: to disseminate knowledge, and, incidentally, to enhance his scientific reputation. The factor of financial profit may be quite subordinate to his main purpose.

The remarks that follow are addressed to those forestry-writers who aspire to the nonprofessional group. Those who would become professional authors will waste their time reading further because the present writer unfortunately cannot help them. He himself is not a professional.

In general the forester has four outlets[2] available for his articles: (1) Technical and scientific journals; (2) popular magazines on outdoor subjects; (3) trade papers and semitechnical periodicals; and (4) newspaper feature sections.

Let us examine the possibilities in each of these groups.

(1) Technical and scientific journals are edited and published by and for technicians and scientists. Frequently foresters write for those devoted to general science, soil and water conservation, forestry, soil chemistry, land utilization, wildlife, agriculture, horticulture, botany, genetics, ecology, pathology, entomology, economics, geology, engineering, and for the various governmental periodicals in these and allied fields.

Among periodicals of this type are the JOURNAL OF FORESTRY, *Ecology*, *Phytopathology*, *American Journal of Botany*, *Science*, *Scientific Monthly*, *Journal of Wildlife Management*, and *Soil Science*.

Those journals published by professional organizations, such as the Wildlife Society, seldom, if ever, pay for contributions. Those owned and issued by publishing houses sometimes do. In point of fact, to have an article published in this type of magazine is commonly considered a mark of distinction in itself. Many scientists and professional workers with reputations as distinguished and prolific writers seldom receive pay for an article. A few outstanding and original articles in technical journals may have a more lasting and beneficial effect on a forester's advancement—and salary—than a hundred ephemeral paid articles in popular magazines. The young forester who aspires to write is well advised to keep this point in mind. If he considers the credit first, and becomes a good writer, the cash will come later.

(2) Many magazines publish articles similar in character to those in the scientific and technical journals, but written in more popular style and intended for more general circulation. In this group are the periodicals devoted to nature, the outdoors, farming, forestry and conservation for the layman, hunting and fishing, sports, hob-

[2]One of the handiest sources of reference for the forestry-writer is the *Directory of Newspapers and Periodicals* published by N. W. Ayer and Son, Philadelphia, Pa. It is issued annually. In it are classified all the periodical publications in the United States and Canada, listed by states and places of publication, and arranged by subject matter. The book is expensive, but it is usually to be found in public and institutional libraries.

bies, adventure, travel, and juvenile interests.

Among the many magazines in this group are *American Forests, Nature Magazine, Southern Agriculturist, Farm Journal, Field and Stream, Outdoor America, Boys' Life, Travel, Popular Science, Natural History, Trees, Recreation,* and *Country Life.*

Most of these publications customarily pay for contributions, but unless they have large circulations their space rates are not high. Usually they are profusely illustrated, well written in an entertaining and informal way, and as a rule somewhat more attractively printed than the technical and scientific journals. Writing for them as a part-time interest is an agreeable occupation. It is not apt to be highly remunerative in the long run, however, because frequently the editors are well stocked with manuscripts, and the competition, more often than not, is very keen.

Sometimes an editor will solicit an article on a definite subject, to be treated in a specified manner, from a writer who has previously contributed articles of the type wanted and with whose capabilities the editor is acquainted. A forestry-writer who has written fairly widely and reasonably well, so that he has established a modest reputation, occasionally may be invited to write articles "on order." On one hand, working on order is the most satisfactory kind of writing because the author knows beforehand what the editor wants, and he undertakes the assignment knowing that the article will be published. On the other hand, writing to order may be irksome if the author agrees to supply an article on a subject in which he subsequently finds he has little interest or which requires time-consuming research.

The most difficult article the present writer ever wrote was one solicited by a magazine which wanted a "fresh slant" on the Civilian Conservation Corps. The C.C.C. had been in existence about six months and during that period he had been turning out copy about the Corps almost daily. When he started to fill the assignment he found that he was about "written out" on the subject.

(3) Trade papers and semitechnical periodicals offer outlets for a variety of articles by forestry-writers. In this group are the trade journals of the lumber industry and the pulp and paper industry; semitechnical periodicals on engineering, radio, mechanical equipment, wood preservation, wood utilization, automotive and agricultural machinery; and house organs of individual manufacturing companies.

These publications usually accept factual articles only. Their editors like descriptions of new ways of doing things. Literary flourishes are definitely not wanted; plain, simple writing is the thing. Some trade journals and semitechnical periodicals pay for contributions, but their rates are generally low.

Among the numerous periodicals in this group are *The Timberman, Hardwood Record, American Lumberman, Paper Trade Journal, Wood Preserving News, Modern Plastics, Home Craftsman, American Nurseryman,* and *National Safety News.*

(4) Newspapers, particularly the Sunday feature sections, publish each week innumerable articles on a wide variety of subjects. The essential requirements of feature articles are that they be entertaining, instructive, easy to read, and fairly brief. Most are written by staff writers, but many are contributed by free-lance writers. Payment is by space rates which are rather low. One or two good photographs will help place an article which otherwise might be rejected.

Writing feature articles for newspapers provides a splendid means of keeping the public informed about conservation. The young forestry-writer will find this field particularly inviting if he can master the mechanics of feature article writing. This subject[3] has previously been discussed in the JOURNAL.

All four groups are legitimate and suitable outlets for the forester's contributions. A fifth group should be mentioned, but it is almost entirely the province of the professional writer, though occasionally a nonprofessional writer breaks into it. It is made up of the well known magazines of great national circulation, such as *Country Gentleman, American Magazine,* and *Saturday Evening Post;* and the quality, literary magazines, such as the *Atlantic Monthly* and *Harpers.* The fact that these magazines occasionally publish articles by foresters proves that in creative writing the only limitations are the author's ability and diligence.

[3]Clepper, H. E. Writing the news of forestry. Jour. Forestry 32: 63-67. 1934.

ECONOMIC ASPECTS OF COOPERATIVE MARKETING OF FOREST PRODUCTS

By WILLIAM T. HICKS

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The successful functioning of cooperative marketing associations in a number of fields has caused foresters to wonder how far this type of organization is adaptable to the handling of forest products. In two previous articles in the Journal of Forestry[1] a number of possible advantages and disadvantages of cooperative marketing of timber were brought out. In the present article the analysis of this type of organization is carried a step farther by discussing several phases of cooperatives in general as related to theoretical possibilities of forestry cooperatives. Economic aspects alone are considered. No feature is completely covered, but it is believed that the success of cooperatives in other fields indicates favorable opportunities in forestry.

The cooperative type of organization has achieved widespread adoption in the American business world. In 1936 the 10,500 active farmers' cooperative marketing associations in the United States had 3,550,000 members. Roughly three-fourths were members of cooperative selling associations and one-fourth of cooperative purchasing associations. If duplication in membership—one farmer may belong to more than one association—is omitted, approximately thirty percent of American farmers apparently sold products through one or more associations.

Moreover, manufacturers, wholesalers, and retailers belong to trade associations, a type of cooperative organized to distribute market information or accomplish undertakings of mutual interest to members. The U. S. Department of Commerce in 1937 listed 271 national and interstate trade associations in lumber and related forest industries, and 600 in the construction industry. In 1929 the Federal Trade Commission gave an estimate of 395 cooperative grocery associations, the best known being the Independent Grocers Alliance with a membership of around 10,000 independent retail stores in 42 cities. Twenty-four cooperative drug chains were estimated to be operated by 6,041 independent retailers during the same year. During the past fifteen years cooperative associations and cooperative undertakings have become a common characteristic of business.

Many types of cooperatives, designed for many purposes, have operated in the United States. The type to which the term "cooperative marketing association" is most familiarly applied is characterized by several features. Each member is usually allowed only one vote in formulating policies. Savings are distributed to members in proportion to the volume of business transacted through the association. Membership is limited to individuals engaged in the same type of business undertaking. Such characteristics usually apply to both cooperative selling associations and cooperative purchasing associations. However, the term is often limited to associations designed primarily to sell goods produced by members, and this type of organization is the one discussed in this article.

From a social viewpoint a cooperative association is economically justifiable only if distribution can be more efficiently performed by this type of organization than by independent action. Greater efficiency must result in a higher net return to the producer, a better quality of product, or a lower price to the consumer. A cooperative designed simply to raise the price of a product through monopolistic control of the supply is socially undesirable, as it then becomes merely an instrument with which to extract extra purchasing power from the consumer.

Functions of Cooperatives

The cooperative marketing association is not, *per se*, more efficient than are private middlemen. The marketing functions of assembly, selling, transportation, standardization and grading, risk bearing, and financing must be performed. Performance is both difficult and expensive, requiring skill and experience. A cooperative may eliminate marketing funtionaries, but it cannot eliminate marketing functions.

In many fields, however, cooperative marketing associations have been unusually successful.

[1]Murphy, F. T. Cooperative timber marketing. Jour. Forestry 35:448. 1937.

Aaltonen, F., C. S. Herr, and K. E. Barraclough. The cooperative marketing of forest products. Jour. Forestry 36:203. 1938.

Particularly has this been true with dairy products, grain, livestock, cotton, fruits, and vegetables. Local, regional, and national groups handling these products have developed. Nationally known associations include the American Cotton Cooperative Association, the Farmers' National Grain Corporation, the National Livestock Marketing Association, the Florida Citrus Exchange, and the California Fruit Growers Association. Marketing functions have been so efficiently performed by these associations that both cooperative members and consumers have benefited.

In addition to performing the customary marketing functions, many cooperative associations have found it desirable to supervise actual production by members. A more uniform and higher grade of material can thus be assured. Likewise, some groups have found it advisable to construct processing plants in order to develop a satisfactory market. Associations of citrus growers, for instance, often supervise the groves during growing season, completely harvest the crop, operate packing and canning plants, all in addition to performing the normal marketing functions.

Possibilities of Forest Cooperatives

It is illogical to assume that because of success with other products, cooperative associations will necessarily improve the present marketing system for forest products. A cooperative association, it is true, possesses a number of theoretical advantages, but it also possesses certain specific disadvantages. Efficient managers are often not available. Adequate financial support is difficult to obtain. Inefficient managers and insufficient capital have caused the failure of many cooperatives handling various kinds of agricultural products in past years, sometimes with serious loss to members. Moreover, in many regions there is not sufficient volume of forest products for sale to carry the overhead of a cooperative. And in all regions resistance could be expected to the idea of a new type of marketing agency.

Nevertheless, it is also illogical to assume that because of past failures and theoretical objections to cooperatives the possibility of improving the marketing facilities in given areas by means of forestry cooperatives does not exist. Successful activities of cooperatives in other fields do indicate similar possibilities with forest products.

The success of cooperatives in stabilizing the market for specific products indicates a similar possibility for forest cooperatives. A stabilized market would tend to reduce uncertainty for forest owners, and at the same time increase the reliability of the source of supply for forest industries. Undesirable practices can likewise be more easily eliminated in an organized than in an unorganized market.

In local areas where existing channels of distribution were not efficient for given products, cooperatives have offered improvement. Although this condition may not be as common for forest products as for certain other items, it does exist. For instance, if no satisfactory market exists for a given forest product, or if the market is monopolistically controlled by utilization plants, a forestry cooperative would probably tend to improve the situation. However, when cooperatives provide facilities merely duplicating efficient existing agencies, only loss can be anticipated.

From a forestry viewpoint, one of the most favorable opportunities for a cooperative appears to be in the uniform grading of product for individual members. Grading, or classification of wood for its highest utilization, is usually impracticable for an individual small producer, but a cooperative could make separate sales to lumber mills, treating plants, and pulp mills. Industrial users would thus have a more stable supply of specific grades of wood, while the returns to the members would be enhanced by selling each grade for its highest use. Grading of many agricultural commodities was uncommon until practiced by cooperatives.

Opportunities for improving the management of forest land are found in many areas. A cooperative association that would supervise the management of forest land and thereby produce a higher grade product, as well as market that product, appears practicable. Cooperatives handling fruit, as previously mentioned, successfully supervise production and perform all harvesting operations. The cooperative not only encourages the production of a higher grade product, but makes such production profitable by providing a market. The expense of hunting a buyer for ten highgrade poles might be uneconomical, but when these poles are combined with others handled by a cooperative, an economical sale may be made.

In some instances cooperatives have found it desirable to develop processing plants to assure a more stable market. Dairy cooperative associations have established creameries; citrus growers' associations have established packing and can-

ning plants; fruit and vegetable groups often operate canneries. In areas with inadequate plants to utilize forest products, cooperative associations may be instrumental in establishing improved facilities.

The possibilities of cooperative forestry associations are not altogether theoretical. Several associations have been organized. The Otsego Forest Products Cooperative Association, Cooperstown, N. Y., and the Forest Products Association, Inc., Grovetown, N. H., are two examples. The Farmers' Federation, Inc., Asheville, N. C., affords an example of a cooperative handling pulpwood along with other farm products. The success or failure of such organizations will show a significant trend in the potentialities of forest cooperatives.

Governmental Assistance

Various governmental agencies have attempted to improve the marketing of a number of products. The Bureau of Agricultural Economics, the old Federal Farm Board, the Extension Service, and the Farm Credit Administration in particular have rendered aid in marketing agricultural commodities. News services, crop reporting estimates, establishment of grades, control of exchanges, and sponsorship of cooperatives are among the important activities. Sponsorship of cooperative associations has been in the form of recommended plans of organization, of active encouragement and support, and of direct financial assistance through loans. At present nothing indicates that legal aids open to cooperatives in general are not available to cooperative handling forest products either exclusively or in conjunction with other agricultural products.

A number of federal acts have been passed encouraging cooperative associations. The Clayton Act passed in 1914 stimulated the formation of non-stock cooperative associations by exempting them from anti-trust laws, while the Copper-Volstead Act of 1922 gave the same privilege to capital stock cooperatives. In 1926 cooperatives were exempted from payment of an income tax. The Agricultural Marketing Act of 1929 in turn established a $500,000,000 loan fund, administered through the Federal Farm Board, from which cooperatives could borrow. The Farm Credit Administration and Agricultural Adjustment Administration have continued the policy of providing credit and encouragement for such associations.

A number of states have special cooperative marketing association laws, usually granting certain privileges to cooperatives organized to handle agricultural commodities. In most such acts forest products are specifically designated as an agricultural commodity. Customarily two types of associations are provided for under state laws —capital stock and non-stock. Of existing cooperatives, slightly more than half are organized as capital stock associations.

Governmental aid in marketing forest products has been limited. The U. S. Forest Service, however, had aided through the work of the Forest Products Laboratory in developing new products and through various activities designed to improve management of forest land to yield products of better quality. The Forest Products Division of the Bureau of Foreign and Domestic Commerce cooperates with private firms in collecting and distributing marketing information. In addition, extension and state foresters have at times furnished market information about forest products to timber owners.

Generalized Conclusions

1. Theoretically cooperative associations offer an opportunity of improving the management of forest land, of improving marketing facilities in areas where existing facilities are relatively inefficient, and of bringing about improved utilization where an expansion in capacity of specific types of plants is practicable.

2. A newly organized forestry cooperative association faces a grave problem in securing efficient management and adequate finances.

3. Existing cooperatives handling forest products offer criteria as to the future possibilities of the success of such a type of organization.

4. Legal machinery exists for the organization and financing of cooperative marketing associations handling forest products.

SPECIALIZED FORESTRY CURRICULA VERSUS THE LICENSING OF FORESTERS BY STATES[1]

By H. H. CHAPMAN

Yale University

Before the profession of forestry will gain the public recognition and inspire the public confidence enjoyed by many of the older professions, it will be necessary to define more sharply than they are now defined the minimum educational requirements, or their equivalent, of those who are accepted by the profession as members. For several years Professor Chapman has focussed attention on this very important problem, but, largely because of the apathy of the forestry schools themselves, little progress has been made. While there may be some difference of opinion concerning the details of how the problem should be solved, there can be little if any difference of opinion concerning the need, if not the absolute necessity, of facing it fearlessly and squarely.

WHAT is the traditional field of professional foresters? In European countries, exclusive, until recently, of Great Britain, the profession of forestry which comprises professional foresters, is clearly defined, and, as in the case of other professions such as law, medicine, and engineering, it is based on a body of professional knowledge which must be acquired before the individual is recognized as a member of the profession. In the United States, professional standards have been set up by the Society of American Foresters in which qualifications for the initial grade of Junior member are based on the acquisition of "theoretical training in the fundamental principles of professional forestry." For this grade, practical or field training is not required. If the candidate is a graduate of a school of forestry approved by the Council, he is accepted, in the absence of protests after publication of his name, on the sponsorship of three members. For those not graduates of such institutions, the requirement of the Constitution is that they shall show proof that "they have acquired an adequate understanding of the basic economic, business, and technical facts and principles sufficient for the foundation of a professional career in forestry and substantially equivalent to the training given in a school of forestry approved by the Council," in whose hands is left the formation of the required proofs of such qualifications.

For Senior membership, based on these educational qualifications for Junior membership, there is added the requirement of ten years' experience, for which the Junior qualifications are accepted as equivalent to six years. Not only does the Senior grade of membership require the demonstration of technical ability, character, and responsibility, but persons who have previously qualified as Junior members are accepted from various fields of activity such as landscape, park, and recreational work, grazing and wildlife, and the utilization of forest products. These qualifications are clearly set forth in the new by-laws issued in July 1938. It is the considered attitude of the Society, therefore, that an individual is not a professional forester unless he possesses these educational qualifications, though acceptance by the Society for membership is merely the profession's testimony to that effect, based on submitted evidence. Still further proof is required before the profession through its organized body will endorse him as a competent practicing forester.

Forestry encounters the same difficulties that the engineering professions encounter in distinguishing between professional and vocational grades. The same difficulty is noticed in game management in distinguishing between game keepers and professional game experts or managers. Individuals possessing only practical vocational training obtained in the field are invaluable in carrying out practical operations, and on their shoulders will continue to rest most of the ultimate operations, just as, in agriculture, the farmer *applies* his own experience plus whatever professional advice and direction he can be induced to adopt. The construction foreman builds the bridge or skyscraper, the plans of which are made by professional men. In the American Society of Mechanical Engineers, advancement to professional grades is based on liberal requirements, and the door is open to men not having college training, provided they develop the professional knowledge required.

In the Society of American Foresters also the

[1]This article was submitted to the Division of Education at the annual meeting at Columbus, Ohio, on December 15th, and deals only with conditions existing on that date.—H.H.C.

by-laws provide for the acceptance of men, regardless of college training, provided they can submit adequate evidence of having acquired this body of professional knowledge equivalent to the standards set for accredited professional schools. The intent here is perfectly clear, but in practice it is difficult to secure this proof in adequate form. Sponsor statements for Junior membership are apt to be perfunctory and to overlook the fact that the only concern of the Society for this grade is the educational requirement, and that practical experience is only of value insofar as it offers proof of the acquisition of knowledge equivalent to the educational requirement. Otherwise the candidate merely demonstrates his vocational qualifications, for which the grade of affiliate member is provided. Objection has even been raised to the requirement of furnishing a transcript of such forestry courses as may have been taken by the candidate.

Recently, the sentiment has been expressed that the standards of the Society should be raised by stiffening the requirements for accrediting new schools of forestry and this proposal is being considered. But the real need is for uniformity of professional requirements for the Junior grade, and this can only be obtained by a more effective application of the tests of professional knowledge exacted of men *not* graduates of accredited schools. The responsibility for these tests rests first on the sponsors, next on the Sections, and finally on the Council. It is in this matter of enforcing uniform, rather than in higher requirements, that progress is needed.

A second great, and so far insurmountable, obstacle to defining the "traditional field" of professional foresters is the utter failure of the profession so far to formulate the requirements of this field. Accepting as a basic premise that professionally the field is defined by educational standards, the basis of all professional education is the curriculum, rather than the institution as a whole. In the work of the Engineers' Council for Professional Development the basis of accrediting is the curriculum and not the school. The curricula listed are aeronautical, architectural, agricultural, ceramic, civil, chemical, communication, electrical, geological, industrial, mechanical, metallurgical, mining, petroleum, public health, and transportation. Under each institution is listed the curricula which are accredited. The accrediting is based on a statistical report, contents of which closely parallel that required by the Society, plus qualitative data evaluated through visits of inspection by a committee or committees of qualified individuals representing the Council. These instructions are as follows:

Basis for Accrediting Engineering Colleges, 1937

The following statement proposed by the Committee on Engineering Schools and approved by the Council and by the Constituent member organizations, embodies the principles in accordance with which accrediting is conducted.

I. Purpose of accrediting shall be to identify those institutions which offer professional curricula in engineering worthy of recognition as such.

II. Accrediting shall apply only to those curricula which lead to degrees.

III. Both undergraduate and graduate curricula shall be accredited. (Accrediting program at present embraces undergraduate curricula only.)

IV. Curricula in each institution shall be accredited individually. For this purpose, the E.C.P.D. will recognize the six major curricula: Chemical, civil, electrical, mechanical, metallurgical, and mining engineering—represented in its own organization and such other curricula as are warranted by the educational and industrial conditions pertaining to them.

V. Curricula shall be accredited on the basis of both qualitative and quantitative criteria.

VI. Qualitative criteria shall be evaluated through visits of inspection by a committee or committees of qualified individuals representing the E.C.P.D.

VII. Quantitative criteria shall be evaluated through the data secured from catalogs and other publications, and from questionnaire.

VIII. Qualitative criteria shall include the following:

(1) Qualifications, experience, intellectual interests, attainments, and professional productivity of members of the faculty.

(2) Standards of quality of instruction:
- (a) In the engineering departments
- (b) In the scientific and other cooperating departments

(3) Scholastic work of students.

(4) Records of graduates both in graduate study and in practice.

(5) Attitude and policy of administration toward its engineering division and toward teaching, research, and scholarly production.

IX. Quantitative criteria shall include the following:

(1) Auspices, control, and organization of the institution and of the engineering division.

(2) Curricula offered and degrees conferred.

(3) Age of the institution and of the individual curricula.

(4) Basis of and requirements for admission of students.

(5) Numbers of students enrolled:
- (a) In the engineering college or division as a whole.
- (b) In the individual curricula.

(6) Graduation requirements.

(7) Teaching staff and teaching loads.

(8) Physical facilities. The education plant devoted to engineering education.

(9) Finances: Investments, expenditures, sources of income.

Information supplied by means of the questionnaire, or otherwise, is for the confidential use of the E.C.P.D. and its agents and will not be disclosed without the specific written authorization of the institution concerned.

Of these qualitative criteria (Sec. VIII), the

Society now secures statistical reports on 1, 2, and 4, and considers 5 in its report.

Efforts to secure practical consideration and analysis of this problem of curricula by the Division of Education of the Society of American Foresters have repeatedly evaporated. No committee with power to recommend action has ever been appointed by this Division. So far, the final power for decision on curricula is given, in the Constitution and by-laws, to the Council, which exercised its authority in one instance, that of the curriculum on Paper and Pulp, at the New York State College of Forestry. This leaves the situation in the chaotic condition that as long as the institution itself passes the standards set up, any course whatever, regardless of its contents, if it leads to a degree by the forestry department of this institution, qualifies its recipient automatically as a Junior or professional member of the Society; hence of the profession of forestry.

Thus the individual schools, and not the profession, have so far been the arbiters, not of what they should teach, which is their right, but of what constitutes a professional forester, which is definitely the responsibility of the profession and not of the schools alone. The stronger schools have shown the greater tendency to branch out, adding specialized curricula devoted almost exclusively to some branch of land management, such as recreation, game, or grazing, or concentrating on phases of utilization to the exclusion of other branches of forestry. Let me emphasize again that all these subjects, and their practice, are accepted as qualifying for Senior membership provided the candidate *first* has acquired what the Society considers a sound basic professional training as a forester, and provided the practice is tied in directly with forestry.

That such a professional basis exists in other countries is unquestioned. That in the various engineering curricula a professional basis is required for *all* engineers, on which the special curriculum is built, is equally well established. In forestry, on the contrary, the coordination of other phases of land management with forestry activities is so close and so increasingly emphasized that the cleavage in four-year curricula tends to become vertical and to destroy or render impotent any common professional basis of educational training. The influence of the stronger and more specialized institutions has nullified the efforts of the Society to formulate such a basis. Without some agreement on the existence of this common professional body of knowledge, forestry becomes instead of a profession a loosely bound aggregation of miscellaneous subjects based, on the one hand, on land management for everything but agriculture, and on the other, on all forms of utilization of forest products irrespective of land management.

Of course, one primary difficulty lies in the effort to give adequate special instruction in a four-year course. This can be done only by eliminating most of the basic training in other related fields covered by forestry. With the advent of a fifth year and postgraduate instruction, there is a better chance not only for an adequate forestry base, but for the cultural subjects the loss of which is so widely bemoaned.

The trouble with forestry is that actually it covers a far broader field than any other profession. Engineering, regardless of its specialties, has a mathematical base, and only recently has much attention been paid by engineers even to the field of economics. Law and medicine are specialized fields. Forestry as such is not specialized. It requires a basis of engineering, biology, economics, and business management. A forester as a professional man may be called on for a timber estimate, survey, and map; for construction of roads, buildings, and other engineering projects; for nursery work, planting, and crop tending; for logging; for manufacture or production of forest products; for protection measures against fire, insects, and diseases; not overlooking recent tendencies to demand of foresters advanced roles as saviors of society. Foresters must be trained for a high grade of efficiency as a business executive with all that implies; for public relations including legislation and taxation; and in the intricacies of marketing as well as manufacturing all grades of forest products, such as paper and pulp. Foresters must handle recreational, park, landscape, and tree surgery problems. Foresters must know about game management and grazing, soil erosion, and bureaucratic politics. From this welter of special knowledge must emerge a profession. Can it be done, or is the task hopeless and should we drop the term forester and seek a broader, more inclusive classification, such as land utilization engineer? Is there *any* term that would cover these fields together with products? Or shall we abandon the idea of approving curricula and, as at present, pass only on our institutions as a whole? Should we cease all attempts to require *any* common or basic preparation for forestry as a pro-

fession, and let each institution set up as many separate special curricula for forestry education as it desires and be the sole judge of their adequacy in the professional training of foresters? That is the situation at present and as far as can be judged it may continue to be for some time to come. Until the Society solves this problem we will have no common educational basis for forestry.

Tentative proposals, put up for discussion suggesting such a basis brought forth only negative criticism from the schools. One institution, whose total hours of instruction fell considerably below an indicated minimum, stated that the curriculum made up in quality what it lacked in quantity. When specialized curricula failed to show even a minimum of general forestry, defendants were not lacking to point out the fact that such subjects were an indispensable part of forestry (as in utilization) or of land management (as in game management or grazing) and that the profession would be greatly benefited by accepting as full-fledged professional foresters the graduates of such curricula, who otherwise might go off by themselves and form other professional groups. This overlooks the purpose of the Associate grade of membership. Utilization specialists have asserted that the curricula which are generally given in forestry are in themselves merely specialized training in silviculture or forest production, which without utilization are hog-tied at the start. Thus the matter rests, at present, with a superficial method of accrediting institutions by the Society and no attention whatever paid to the subject matter of instruction in forestry as the basis for a professional ranking. The strong schools do not want anything done; the Division of Education has let the matter rock along; and the Council has not yet forced the issue and demanded a show-down not acceptable to these bodies.

The Society is handicapped by a scale of dues averaging but one-third of that paid by other professional societies, 60 percent of which is absorbed by its publications and most of the rest in necessary routine administration, leaving no surplus for financing a personal study, by inspection, of the curricula in the twenty-four or more institutions on the list. It seems hopeless for the Council to attempt, without cooperation of the schools or the Division of Education, to formulate *any* minimum standards of professional instruction, due to the variables that enter into the problem. Yet it would be difficult to secure uniform grading of curricula on the basis of inspections (as is done by the Engineers Council for Professional Development) in the absence of *any basis* for comparison, or standards for the committee to use. Again, the easy solution has been to accredit the institution regardless of curricula.

The most serious phase of this problem appears in connection with proposals for licensing foresters by individual states. Such licenses presuppose the existence of a profession, based on a body of professional knowledge that can be covered by a comprehensive public examination similar to the bar and medical examinations or those given to engineers. Unless there exists this basic structure of common required knowledge, no such comprehensive examination or licensing is possible, and if foresters are to be licensed at all they would have to be split into groups, such as utilization engineers, landscape and parks, and forest production. With this common basis, men educated as foresters can pass such tests and secure licenses though they may specialize in any of the above fields and in others. As long as undue specialization exists, violent opposition may arise against licensing by means of a comprehensive test.

In the absence of a license system, this so-called profession of forestry is at the mercy of charlatans in private fields and of politicians in public employment. The term is freely appropriated, in both fields, by men almost entirely devoid of professional qualifications. Such men, by the way, frequently seek membership in the Society as a proof of their professional status and in one or two instances have even used political pressure to secure endorsement by professional subordinates for this advancement. One of the most common lines of approach is through timber cruising. The applicant can do as good, or better, a job in this line as most graduate foresters, hence he considers himself fully qualified for professional recognition. This attitude is merely the substitution of vocational special training for scholastic specialization, as a basis for professional status. Why, argues the applicant, should he study up on a lot of branches for which he has no immediate practical use, in order to qualify? On this basis a successful logger or mill superintendent certainly is as well qualified, vocationally, as a graduate of a course in utilization containing no other phases of the professional training, and much hard feeling ensues when one of these practical men is not ac-

cepted on a professional basis. There are many managers of English estates, as well as game keepers on these estates, who have altogether too much to say about the management of the for forests thereon, but the English do not mistake them for foresters, though they would be recognized as such professionally, independent of their duties, if they had the educational background.

The process of raising the standards of a profession must be sharply differentiated from the motives actuating labor unions which seek higher wages and better working conditions. By contrast, professional standards seek the protection of the public against individuals who endeavor, without proper qualifications, to capitalize the reputation for expert professional knowledge and reliability which alone justifies the existence of professions. The licensing of a profession is the direct means by which the public, rather than the profession, secures a measure of protection. The administration of such licensing practices, in turn falls on the profession itself, through the standards set by examinations.

In state service, such licensing accompanied by proper legislative qualifications for state forest service jobs would go far to do away with the present increasing tendency to debauch these services by the appointment of men to responsible positions who have either no professional training or a mere smattering of vocational experience. The licensing of foresters is the next important step in the establishment of forestry on a professional basis in the states. Can the difficulties inherent in the problems of curricula be ignored or overcome by such licencing measures, or will this movement be held up pending some adequate definition of forestry as a body of professional knowledge?

CONTROLLED BURNING IN THE WESTERN WHITE PINE TYPE

By KENNETH P. DAVIS[1] and KARL A. KLEHM[2]

U. S. Forest Service

Controlled burning admittedly is a highly controversial procedure, but the authors show that under certain conditions when adequate precautionary measures are taken it has a definite place in western white pine forest management. More important still, the authors describe the conditions under which it is useful, the precautionary measures that must be taken, the results that may be expected, and the cost of the operation. All foresters dealing with timber management problems will find this paper of outstanding interest and value.

APPLICATION of controlled or broadcast burning, as distinguished from conventional pile-and-burn methods of slash and debris disposal, has been a development of recent years in timber management practice in the western white pine type[3] of northern Idaho.

The Need for Controlled Burning

Controlled burning in this forest type has been employed principally: (1) To reduce excessive fuel volumes in timber stands accidentally killed by fire, and (2) to dispose of large quantities of defective and unmerchantable but live timber remaining after logging in certain kinds of forest stands.

Regarding the first, forest fires in live timber stands leave a maze of dead trees creating a dangerous fuel menace lasting for at least 20 years after the fire. Unless this abnormally high fuel volume is reduced, the danger of a second and even more destructive fire jeopardizes not only natural reproduction that may have become established in such areas but adjacent green timber stands that otherwise might successfully be protected. Such fire traps exist in the white pine forests, and the argument has been often raised that rather than risk an uncontrolled conflagration that may accidentally develop some hot day in midsummer, the practical and wise thing to do is to burn them de-

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[2]Supervisor, Kootenai National Forest, Region One.

[3]The western white pine type is defined by the U. S. Forest Service as mature timber stands containing 15 percent or more western white pine by volume, or immature stands containing 15 percent or more western white pine by number of trees. Under this broad definition, stands classified as western white pine type may be of great silvical diversity varying in composition from almost pure white pine to stands composed mainly of any of the species commonly associated with white pine.

liberately at a time when the fire can be controlled with some degree of certainty. Many of the most serious fires have started in areas of dead timber. Controlled burning in such areas is an obvious treatment to remedy a condition accidentally created whose recurrence is not desired. Decision as to when a particular area warrants this treatment can be made only after careful consideration of all direct and indirect effects. Unskilled or improper burning can do more harm than good. Important items are: area to be treated, fuel volume and its threat to adjacent green timber, character and composition of natural reproduction that may be present, site quality and possibility of site damage by burning, difficulty of *Ribes* eradication (*Ribes* may reproduce so abundantly following fire that their removal to protect white pine reproduction from the white pine blister rust is impracticable), and cost of treatment. Since the importance of each of these items varies greatly by localities, each area must be considered individually.

As to the second, the problem of defective and unmerchantable timber left following logging, the situation is briefly this. Of the six species commonly associated in the western white pine type, only western white pine and western red cedar are of sufficient value to log extensively with existing markets. White pine is of outstanding importance because of the high value and the large volume of the species available. It comprises nearly half of the volume of merchantable-sized timber in the western white pine type. Western red cedar as used for transmission poles commands a high price, but the comparatively small volume of this species (about 3 percent of the total stand of which only a portion is suitable for poles) makes it of much less total importance than white pine. Western larch, Douglas fir, lowland white fir, and western hemlock logs frequently do not have a market value sufficient to pay for the cost of logging and consequently are logged to a limited extent only. A further difficulty is that overmature stands are often heavily defective. Hemlock and white fir are the chief "problem" species in this respect, often being so defective as to practically preclude any present or future merchantability.

The combined result of limited markets and defective timber is that a substantial proportion of nearly all timber stands in the western white pine type is unmerchantable under existing market conditions. This situation is the underlying cause of the most difficult and stubborn management problems in the type.

Sound timber now unmerchantable may, of course, become merchantable in the future. Present policy on national forest timber sales is to avoid cutting sound but unmerchantable timber of all species, reserving it for the future. But timber of low-value species that is also heavily defective is another matter, as there is little if any hope that better markets will solve the merchandising problem. Defective western hemlock and lowland white fir often dominate the stand left after logging the merchantable timber, preventing the establishment and satisfactory development of natural reproduction of more desirable species for an indefinite number of years. Such residual stands are commercially unproductive, yet they can and often do occupy the most productive timber-growing sites. In order to realize on the heavy investments necessary to protect the white pine forests from fire and disease, it is important that these better sites be kept growing timber to their maximum capacity. Controlled burning is an effective means of accomplishing this objective.

A further use of controlled burning to dispose of live timber, given only limited application, is in stands composed principally of merchantable western white pine. On the less exposed aspects as north and east slopes, clearcutting of such stands followed by controlled broadcast burning of the residuum is often a sound silvicultural measure.

It is difficult to specify where controlled burning as a means of disposing of defective and unmerchantable timber should or should not be applied. Decision can be made only after considering each stand in question individually. Anticipated future values of species at present unmerchantable, volume and condition of defective timber, possible site damage, and the cost of controlled burning in comparison with other methods possible are the main points to be considered. As an accurate appraisal of these elements is difficult, there is room for wide difference of opinion as to the extent the method should be applied.

Development of Controlled Burning in Region One

Although discussed for many years and occasionally attempted on a small scale, the real

development of controlled burning and its acceptance as a more or less legitimate management measure dates from 1928. In that year 192 acres supporting large volumes of defective and worthless hemlock on two logged-over areas on the Kaniksu National Forest were clear-cut. On the same forest six more logged-over areas aggregating 433 acres were clear-cut in 1929. Burning of these areas was accomplished with reasonable success and in the ensuing years more such projects were attempted. The Kaniksu Forest pioneered in the development of burning techniques. The Northern Rocky Mountain Forest and Range Experiment Station made one broadcast burn in 1932 on the Priest River Experimental Forest and several from 1934 to 1937 on the Deception Creek Experimental Forest. Several controlled burning projects, beginning in 1935, were successfully accomplished on the Coeur d'Alene National Forest. Broadcast burning has also been done on the Clearwater, St. Joe, and Lolo National Forests.

Practically all of the controlled burns made from 1928 to 1935 were in logged-over stands of mature to overmature live but rotten hemlock,[4] and were individually comparatively small in extent. All were less than 200 acres and most were less than 100 acres in area.

Beginning in 1935, however, controlled burning as a hazard reduction measure in burned-over areas was attempted on a larger scale. In 1935 about 450 acres of fire-killed timber were successfully burned over on the Kaniksu Forest in two successive nights, 400 acres were burned in a single night on the Lolo, and a large area in an old burn was fired on the Clearwater Forest.

By the end of 1937 controlled burning to dispose of defective and unmerchantable timber had been done on about 5,300 acres of logged-over lands in Region One. Hazard reduction in burned-over areas had also been accomplished by controlled burning on 14,300 acres. Practically all of this area is in the western white pine type and all is on federally owned lands.

Most of these controlled burning projects were considered successful. An example of one of them is shown in Figure 1. Although difficulties in fire control were experienced in some instances, in only one or two instances were they serious and then not of major importance considering total accomplishments from this class of work. Fears that controlled burning was unsafe have been largely dispelled by knowledge and confidence gained by experience. Nearly all difficulties encountered in fire control or in getting a satisfactory reduction of fuels can be traced to preventable errors in methodology, such as inadequate preparation before burning, burning at the wrong time, or inept handling of the actual burning. Given proper preparation, favorable weather conditions, and good technique in burning, there is little real danger that fires will escape control.

Methods

Through experience, fairly definite methods of controlled burning have been developed that are applicable in most circumstances.

AREA SELECTION

Good selection and lay-out of the particular area to be treated contributes greatly toward the success of the project. The following items are important:

1. The area should be in units each of which can be completely burned-over in a single day (or night). It is unsafe to leave unburned portions that may burn out disastrously the following day. If the problems of burning technique are at all complex, 200 acres is about a maximum area that can be burned at one time.

2. The boundaries should be as regular as possible. Sharp turns, long fingers, and deep indentations always make for trouble in fire control and at the same time often cause an irregular burn and unsatisfactory reduction of fuels.

3. In laying out the area full advantage should be taken of available fire breaks, such as roads, streams, ridge tops, clearings, and natural openings.

4. If the area selected goes to the top of a timbered ridge, treatment should be extended just over the top of the ridge. This avoids scorching timber on the ridge top and facilitates fire control.

5. In treating one side of a narrow canyon, an area extending from the creek bottom 100 to 150 feet up the opposite slope should also be included. It is difficult to prevent a hot fire from crossing a narrow canyon near the bottom.

[4]Classified as Class C stands in timber marking rules for the western white pine type applied by Region One of the U. S. Forest Service. Class C stands as defined in the Region One *Timber Management Handbook* are, "Overmature and decadent stands containing a large volume of defective white fir or hemlock."

PREPARATION FOR BURNING

1. All standing timber, dead or alive, should be felled. Attempts to burn standing timber have not been successful. It is in this respect particularly that controlled burning as here discussed differs from the so-called broadcast or slash burning sometimes practiced after logging on private lands to achieve cheap slash disposal. Slash burning seldom reduces the fuel volume satisfactorily.

The purpose of felling is to compact the fuels close to the ground so that in the process of combustion radiation will be more effective and result in greater fuel consumption. Trees or snags should ordinarily be felled up and down the slope, and crossing of logs should be avoided. In areas of light fuels, it is sometimes possible to save live western larch trees—which are astonishingly fire resistant—by keeping fuels away from them. It is seldom possible to save trees of other species.

2. It is usually worth-while to lop limbs from at least the top side of felled trees lying within about 50 feet from the outer edge of the area, and to bunch slash by hand along the edges. This makes fires much easier to start and promotes consumption of fuels along the edges where the greatest difficulty in getting a good burn is usually experienced. Lopping and occasionally some bunching of slash should also be done where a hot fire is not anticipated as in moist bottoms and areas of light fuels. Lopping and bunching is not necessary in areas of heavy slash and in no case should it be done until the felling is completed and the need manifest. Much time can be wasted by unnecessary lopping and bunching.

3. Snags standing outside the area within a distance of 75 to 100 feet should be felled. Where fire control difficulties are anticipated, as at the head of gulches or in low saddles, snag felling should be extended for 200 feet or sometimes an even greater distance beyond the area to be burned. It has been found that standing snags outside the area are one of the principal hazards in burning. Such snags are readily ignited by flying sparks even when ground fuels are too damp to ignite from sparks.

4. A firebreak approximately 20 feet wide, cleared of all logs and branches, but not the natural duff, should be constructed around the area except where natural firebreaks are available. This width has been found sufficient. Fire fighting experience has amply shown that if a fire will jump a 20-foot firebreak, it will also jump a much wider one and a few feet more or less makes little difference. Control in burning is based more on good preparation, favorable fuel and weather conditions, and skillful direction of the actual burning than on firebreaks. No comparatively narrow firebreak, 20 or even 50 feet in width, will actually stop a fast-travelling fire; a width of several hundred feet may be insufficient.

5. A fire trench dug to mineral soil within the firebreak is seldom needed completely around the area. Fire trench should be constructed before burning only in areas of heavy duff and rotten wood, where the need is definitely apparent.

WHEN TO BURN

Determination of the best time to burn necessitates careful evaluation of weather, fuel, and safety factors. Hard and fast rules are not possible, as much depends on judgment. Methods developed in Region One to measure fire weather and forest inflammability should be used as a guide.[5,6] The fall is the best season in which to burn. Weather and fuel conditions should be such that fire will spread and burn hard in the treated area while at the same time fuels outside are too damp to ignite from sparks. Duff moisture *must* be above 10 percent and should be 13 percent or more. The fire danger class, by the Northern Rocky Mountain scale, all factors considered, should be 4 or lower. This will insure medium or lower rates of spread. These conditions are most nearly realized between 4 and 7 p.m. on a calm, clear day two or three days after the first fall rain of 0.5 inch or more. At such a time, the more or less compacted fuels in the treated area, which have been thoroughly dried out during the summer, are still comparatively dry except for surface moisture, while the moisture content of the duff and light fuels outside the area is too high for them to be ignited by sparks and embers. Under such conditions, very hot fires can be permitted with almost perfect safety. Burning should *not* be attempted immediately (i.e., a few hours)

[5] Gisborne, H. T. Measuring fire weather and forest inflammability. U. S. Dept. Agr. Circ. 398. 58 pp., illus. 1936.

[6] Hornby, L. G. Fire control planning in the Northern Rocky Mountain region. Northern Rocky Mountain Forest and Range Exp. Sta. 179 pp., illus. 1936. (Multilithographed.)

Fig. 1.—Controlled burning. Coeur d'Alene National Forest, Idaho.
A. Stand of defective and unmerchantable hemlock left after logging.
B. Similar stand after felling, ready for burning.
C. Burning.
D. After burning, ready to plant.

preceding an impending storm, as weather changes may be sudden and unpredictable. An unexpected wind, for instance, may cause serious trouble. The U. S. Weather Bureau should be consulted in advance to determine the likelihood of dangerous winds during the burning period.

The fuel volume also has a large bearing on the success or failure of burning. Heavy fuel concentrations will generate sufficient heat to burn satisfactorily when fairly green or damp from recent rains. Actually, the heavier the slash the more safely it can be burned, as burning can be done when the fire danger is low. Light or scattered slash, on the contrary, must be burned when relatively dry and the fire danger consequently high or the fire will not spread and consume the fuels satisfactorily. Green timber can be felled in the spring and early summer and burned the same fall provided about 60 days elapse between felling and burning.

Burning in the spring is seldom successful because, while the outside of branchwood and logs may be dry at such times, the inner portions are usually too wet to be consumed. It is therefore difficult to accomplish the elimination of more than the finer fuels. Once a fire has covered an area and consumed the finer fuels, it is almost impossible to get a satisfactory fuel reduction by a second fire except during midsummer when burning is too hazardous to be attempted. Another objection to spring burning is that fires may hang over and break out at inopportune times during the summer fire season.

Protection problems must also be taken into account. If the surrounding area is covered with dangerous fuels, weather and fuel conditions must be very favorable to get a satisfactory reduction of fuels and at the same time avoid the spread of fire outside of the prepared area. *Within limits of safety*, however, the drier the better. It is much easier to direct the fire when the fuels are dry since fires can be started readily and their spread more effectively regulated.

BURNING TECHNIQUE

Although proper preparation, favorable weather, and suitable fuel conditions contribute greatly to the success and safety of controlled burning, much depends on skillful direction of the actual burning. Though there is no substitute for experience and judgment, three fairly definite firing techniques have been developed that can be applied in most situations.

1. Center firing, largely developed on large level areas on the Kaniksu National Forest, is recommended wherever applicable. Instead of following one's natural inclination and starting fires along the edge, the first fires are started in the center and allowed to spread until a large volume of heat is generated. In areas larger than about 10 acres, a second series of fires are then started around the area 50 to 100 feet in from the outer edge. These fires merge, are drawn toward the hotter fire in the center, and slowly back out to the extreme outer edge of the area. Steps in the application of this method are diagrammatically illustrated in Figure 2. Through center firing, smoke, heat, and sparks are drawn toward the center. This makes it easier for men to work around the edges and also reduces the likelihood of spot fires outside. Contrary to what might be expected, fires started in the center will seldom "run" toward the edge. The large volume of heat in the center acts as a stabilizer preventing rapid outward spread. Wind velocities toward the center of from 8 to 10 miles per hour have been observed along the edges of center-fired areas.

While experience on slopes is limited, it is believed that the method can be applied on slopes up to about 20 percent. On steeper slopes, the natural up-draft is likely to be stronger than the center draft developed by center firing. An aid to center firing on slopes is the natural down-draft that develops in the evening in most mountain valleys.

2. Strip firing is necessary on slopes greater than about 20 percent. The method is diagrammatically illustrated in Figure 3. The first fires are started along the extreme upper edge. As soon as the upper edge is well burned over, a second strip or band of fires is started 100 to 200 feet down the slope, which burns up to and joins the upper strip. This process is successively repeated until the entire area is burned over, the last series of fires being set along the lower edge. Strip firing insures that the entire area will be evenly burned over and at the same time avoids a large volume of fire at any one time, which may become dangerous and unmanageable on steep slopes.

3. Edge firing consists of starting fires along the outer edge of an area and letting them spread toward the center. The method is appli-

cable on small areas of an acre or two, or as an auxiliary to strip and center firing on larger areas. As an auxiliary method it is chiefly useful to fire small gulches often included in large areas. These gulches should be fired along the edges on both sides, the fire backing down into the gulch from both sides simultaneously. This helps to prevent whirlwinds which scatter sparks far and wide from developing in these gulches. The firing of large areas from the edges is unsafe as dangerous "runs" against one side may develop. There is no strong center draft as in the case of center firing, or natural up-draft as in the case of strip burning on slopes, to direct fire spread. Smoke and sparks have a tendency to blow outside the broadcast area, making fire control difficult.

A combination of center, strip, and edge firing methods can often be employed to advantage in a single area. Each gulch, knoll, slope, and change of fuel type presents an individual problem in technique that must be accurately appraised before burning.

Two general principles of burning technique are (1) never start fires when the direction of spread is uncertain, and (2) never allow a dangerous travelling "front" to develop. Although these principles are perhaps easier stated than followed, they are none the less requisite to successful controlled burning. Not the least requirement is courage to wield the torch.

Fire Protective Measures and Equipment

Sufficient manpower and equipment should be on hand during burning to meet promptly any fire control need that may be reasonably anticipated. Men should be stationed around the

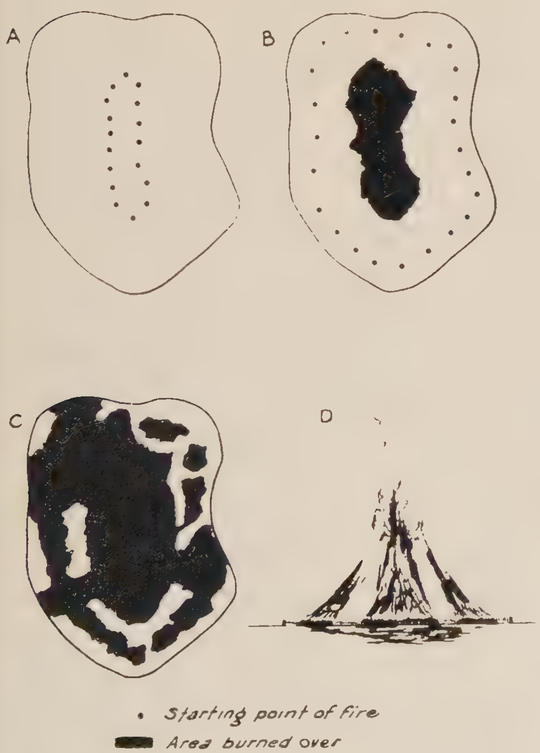

Fig. 2.—Diagrammatic illustration of center firing method of burning. A.—First fires started in center of area. B.—Fires in center united; second series of fires started near edge. C.—Inner and outer fire beginning t merge; fire spreading out to edge of area. D.—Cross-sectional view of C showing smoke and flame drawn toward center.

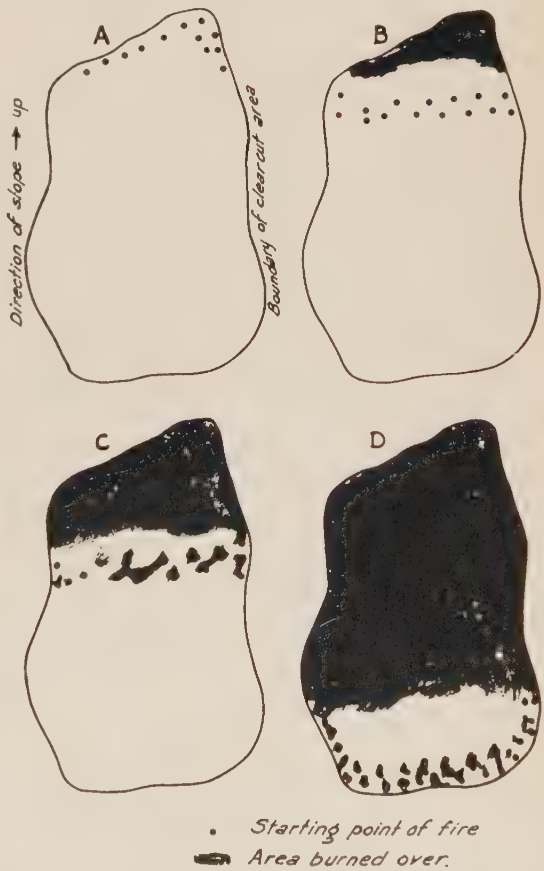

Fig. 3.—Diagrammatic illustration of strip firing on slopes. A.—First fires started along extreme upper edge. B.—As soon as upper edge is well burned out, second strip of fires started 100 to 200 feet down the slope. C.—Third strip of fires started. D.—Final strip of fires started along lower edge.

area in accordance with expected need, danger spots being especially guarded. In addition to the usual small tools, which should include a liberal supply of shovels, a number of back-pack water pumps should be provided whenever water is available. These pumps are very effective in extinguishing spot fires outside the area. Power pumps are useful to wet down fuels outside the firebreak, and to cool excessively hot fires inside the firebreak. Brush burning torches using propane gas are especially recommended as they can be lighted with a match without preheating. They are superior in this respect to torches burning a mixture of kerosene and gasoline. Where fires can be started easily, wick torches, consisting essentially of a length of iron pipe plugged at one end with a wick at the other and filled with kerosene, are useful. Matches alone are sometimes sufficient to start fires.

Regeneration Following Burning

Prompt and complete regeneration following burning to the most valuable species is essential to realize on the rather heavy investment made. On large areas this requirement can be best met by planting. As controlled burning is usually practiced on good sites, successful planting is ordinarily not difficult. Planting ordinarily should be done the spring following burning. Exceptions are: (1) Planting sometimes should be delayed for a year or two to give the mat of roots from a dense residual stand time to decay. These roots are an obstacle to planting. (2) In certain areas where western white pine is to be planted, it has been deemed necessary to delay planting for about three years to permit eradication of *Ribes* seedlings that sometimes appear abundantly following burning.

Natural regeneration may be relied upon in small areas favorably situated for dissemination of seed from adjacent timber. Except on severe exposures, natural regeneration is usually good on areas broadcast burned.

Costs

The cost of the controlled burning treatment varies mainly with the volume of timber that must be felled and difficulties encountered in burning. Felling is the principal expense; slash already on the ground adds very little to the total cost. As much of this work has been done by emergency labor under the N.I.R.A., C.C.C., and E.R.A. programs, direct cost figures are hard to get. Using day labor paid at going rates for woods work, the following are average figures.

Item	Cost in dollars per acre Range	Average
Felling	18-30	22
Firebreak, fire line, burning, and patrol	5- 8	7
Total	23-38	29

Felling costs have been lower when done on contract. On the Kaniksu National Forest 957 acres on 12 different areas were felled between 1929 and 1931 at an average contract cost of $11.51 per acre. Firebreak, fire line, burning, and patrol costs vary with perimeter. The larger the area the less this cost becomes on an acre basis. The cost of planting, $10 to $12 per acre, must usually be added to felling and burning expenditures, making the average total cost of this class of work about $40 per acre.

Discussion

Controlled burning is admittedly a controversial matter. Arguments usually center around economic, silvical, and politic aspects.

It is of course impossible to foresee the future and predict the future values of species now unmerchantable. Sound timber of any species may have a future value and should not be destroyed. But it cannot be emphasized too strongly that controlled burning as applied removes defective timber of low-value species and not more than incidental volumes of sound timber. It is difficult to conceive that defective timber of low-value species will ever have a market value. This point is often not recognized. Stands of defective timber are often physiologically perfectly healthy; defective hemlock, for instance, will occupy valuable growing space almost indefinitely unless removed. It also should be pointed out that controlled burning in live timber stands has been applied mostly on logged-over areas where the treatment was necessary to leave the area in a timber-productive condition. Reforestation of denuded areas should be considered before controlled burning is undertaken in timber stands of insufficient value to log.

Although the cost may seem high, two things should be kept in mind in judging it. First, any other kind of equally quick and effective treatment *in the kind of stands in which controlled burning is practiced* would cost more.

There is no cheaper alternative if positive silviculture is to be practiced in such stands. Second, and this is applicable to logged-over lands only, if the principle that land must be left in a timber-productive condition after logging is accepted, controlled burning, where necessary, should be regarded as a logging cost rather than as a direct investment. Existing mature timber stands are essentially a gift of nature. Some are in an unsatisfactory silvicultural condition from a social-economic standpoint, and in such stands, only values over and above the cost of leaving the area in productive condition should be considered as legitimately extractable from the land. For instance, suppose that $100 per acre could be extracted from a given area if no after-logging treatment is applied. Assume further that controlled burning, costing $40 per acre including planting, is necessary. If the area is to be left in productive condition, the stumpage value would be $60 and not $100 per acre. This is, of course, an essentially social viewpoint that under existing circumstances, the private individual cannot afford to share.

Silvically, there is room for difference of opinion on the merits of controlled burning. Much remains to be learned of the exact physical and biochemical effects of burning on the soil and on the development of reproduction. Burning may be beneficial or detrimental depending on circumstances. Without entering into a discussion of the subject, this much may be said. The western white pine forests are naturally fire forests; western white pine owes its present abundance to fire which in the past has halted the successional trend towards a climax forest principally of western red cedar, western hemlock, and lowland white fir. Controlled burning closely simulates a natural process that in all probability has gone on in nature for thousands of years, a process that has produced some of the most valuable stands found today. It must also be recognized that much of the need for controlled burning is temporary and forced by conditions whose recurrence is definitely not desired. As present overmature stands are cut over and put in productive condition, and as high fire hazards now existing are reduced, the need for extensive application of controlled burning will be reduced. It will undoubtedly always have a place, however, as an adjunct to clear-cutting which is a sound silvicultural measure in certain timber stands, especially those consisting of nearly pure, uniformly mature, and merchantable western white pine.

Esthetically, controlled burning is not pretty; it is certainly strong-arm forestry. But it is not forest devastation any more than ploughing under weeds preparatory to planting agricultural crops is land devastation. It is an admittedly crude but nevertheless quick and effective way of restoring forest lands to timber-productivity. Lands do not stay black after burning; on national forest areas special effort is made to reforest promptly with valuable species. An initially unfavorable reaction to this class of work will largely disappear with a better appreciation of the objectives and results.

After considering the various pros and cons, the authors believe that controlled burning, applied intelligently and with discretion, has a permanent place in western white pine silviculture.

ACCESSIBILITY OF NATIONAL FORESTS FOR RECREATION

By ALICE STUART

U. S. Forest Service

A comparison is made of the nine U. S. Forest Service regions in continental United States with regard to the availability of the national forests[1] for recreation to the regional population.

THIS article is a further development of some results which the author worked up for use by Robert Marshall in his chapter "Forest Recreation for the Low-Income Groups" in the *Recreation Report* of the U. S. Forest Service. His study was for the United States as a whole. This article is a breakdown by regions and the states within them, showing how the population of each region falls into six different cost-zones according to the cost of a round trip to the nearest national forest, thus providing a basis for comparison.

The data employed consisted of national forest base maps, various road maps, the 1930 Population Census for the United States, and an average figure of six cents per mile as the cost of gas, oil, maintenance, and depreciation which a family of four would have to pay on the average in driving to the forest. The assumption was made that if no car were available, the cost of reaching a national forest for a family of four would be at least as much by train or bus.

First of all, on various road maps, the national forest boundaries were drawn, unless they were already present. Cost-zones were then put on the maps by connecting mileage marks which had been placed at intervals on the main roads leaving the forests; 42 miles out was used as the boundary of the first cost-zone, and 83, 125, 167, and 208 miles out as the boundaries of the second, third, fourth, and fifth zones. The sixth cost-zone lay beyond the 208-mile boundary.

The cost of making a round trip to the nearest national forest from anywhere in the first zone at an average cost of six cents per mile is $5 or less; from anywhere in the second, $10 or less; and from anywhere in the next three zones, $15, $20, and $25 or less, respectively. Any place beyond 208 miles lay in the sixth zone where the cost of a round trip exceeds $25.

[1]Forests already established and/or purchase units in which over 20 percent of the purchase unit area had been acquired to June 1, 1938.

The counties located in each cost-zone were tabulated by regions and by states within regions. Their populations were obtained from the 1930 Population Census. By addition, the total population in each zone was then determined for both the regions and for the separate states of which they are composed.

From these data a table was compiled for each region. Each table shows by separate states, as well as for the region of which they are components, the number of people in each cost-zone, and the corresponding percentages. For example, in the Rocky Mountain Region, for the State of Kansas, Table 2 gives the population figures as follows: Zone 1, none; Zone 2, none; Zone 3, 80,786; Zone 4, 127,808; Zone 5, 186,950; Zone 6, 1,485,455; and total, 1,880,999. The percentage figures given for the same zones are: 0; 0; 4.3; 6.8; 9.9; 79.0; and 100.0.

By noting the figures and especially the percentages falling in each cost-zone for the various states in a region, it was easy to see which ones were causing the large regional percentages to fall in the higher cost-zones. For example, 79 percent of the people of Kansas must pay $25 or over for a trip. In the Rocky Mountain Region as a whole, only 54 percent must pay $25 or more. And only 18 percent of the entire United States must pay that much.

For comparing the regions, Table 10 may be used, which shows by regions the cumulative percent of population falling into the six cost-zones. For instance, 34 percent of the population of the entire United States is in the first or second zone, within which the cost of a round trip to the nearest national forest is $10, or less. The Northern, Southwestern, Intermountain, California, North Pacific, and Southern Regions are all above this average, while the Rocky Mountain, Eastern, and North Central fall below.

Since only one-third of the population of the United States can make a trip for $10, the remaining two-thirds must pay more than this

amount. It is of interest to note that this higher cost practically eliminates the possibility of such a trip for those who fall in the lower half of the income scale (under $1,000).

These data showed clearly that the national forests are only reasonably accessible to the recreation-bound public; at the same time they brought attention to areas where, from the recreational point of view, more national forests might be desirable.

Table 1.—Population of Region 1 Broken Down by States and Cost-Zones

State	Cost of round trip to nearest national forest						Totals
	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	
South Dakota	3,589	———	———	———	———	———	3,589
Percent	100	———	———	———	———	———	100
Montana	322,849	117,870	31,056	25,314	14,423	26,094	537,606
Percent	60.0	21.9	5.8	4.7	2.7	4.9	100
Wyoming	200	———	———	———	———	———	200
Percent	100	———	———	———	———	———	100
Idaho	119,942	———	———	———	———	———	119,942
Percent	100	———	———	———	———	———	100
Washington	25,705	150,477	———	———	———	———	176,182
Percent	14.6	85.4	———	———	———	———	100
Totals	472,285	268,347	31,056	25,314	14,423	26,094	837,519
Percent	56.4	32.1	3.7	3.0	1.7	3.1	100

Fig. 1.—National forests and national forest purchase units as of June 1, 1938.

TABLE 2.—POPULATION OF REGION 2 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
South Dakota	56,682	36,572	31,833	19,188	63,189	481,796	689,260
Percent	8.2	5.3	4.6	2.8	9.2	69.9	100
Kansas	----------	----------	80,786	127,808	186,950	1,485,455	1,880,999
Percent	----------	----------	4.3	6.8	9.9	79.0	100
Nebraska	17,186	63,517	142,795	225,522	216,058	712,887	1,377,963
Percent	1.2	4.6	10.4	16.4	15.7	51.7	100
Colorado	717,668	179,656	41,831	74,689	21,947	----------	1,035,791
Percent	69.3	17.4	4.0	7.2	2.1	----------	100
Oklahoma	----------	----------	----------	----------	350,720	718,160	1,068,880
Percent	----------	----------	----------	----------	32.8	67.2	100
Wyoming	98,852	105,100	----------	----------	----------	----------	203,952
Percent	48.5	51.5	----------	----------	----------	----------	100
Totals	890,388	384,845	297,245	447,207	838,862	3,398,298	6,256,845
Percent	14.2	6.2	4.8	7.1	13.4	54.3	100

TABLE 3.—POPULATION OF REGION 3 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
New Mexico	243,305	117,772	24,567	37,673	----------	----------	423,317
Percent	57.5	27.8	5.8	8.9	----------	----------	100
Arizona	166,572	245,613	5,572	17,816	----------	----------	435,573
Percent	38.2	56.4	1.3	4.1	----------	----------	100
Totals	409,877	363,385	30,139	55,489	----------	----------	858,890
Percent	47.7	42.3	3.5	6.5	----------	----------	100

TABLE 4.—POPULATION OF REGION 4 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
Wyoming	21,413	----------	----------	----------	----------	----------	21,413
Percent	100	----------	----------	----------	----------	----------	100
Nevada	52,878	24,050	2,652	----------	----------	----------	79,580
Percent	66.5	30.2	3.3	----------	----------	----------	100
Utah	473,341	34,506	----------	----------	----------	----------	507,847
Percent	93.2	6.8	----------	----------	----------	----------	100
Idaho	227,424	97,666	----------	----------	----------	----------	325,090
Percent	70.0	30.0	----------	----------	----------	----------	100
Totals	775,056	156,222	2,652	----------	----------	----------	933,930
Percent	83.0	16.7	0.3	----------	----------	----------	100

TABLE 5.—POPULATION OF REGION 5 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
California	3,442,426	737,196	781.091	711,799	----------	----------	5,672,512
Percent	60.7	13.0	13.8	12.5	----------	----------	100
Nevada	11,478	----------	----------	----------	----------	----------	11,478
Percent	100	----------	----------	----------	----------	----------	100
Totals	3,453,904	737,196	781,091	711,799	----------	----------	5,683,990
Percent	60.8	13.0	13.7	12.5	----------	----------	100

TABLE 6.—POPULATION OF REGION 6 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
Washington	1,245,614	133,881	7,719	----------	----------	----------	1,387,214
Percent	89.8	9.6	0.6	----------	----------	----------	100
Oregon	858,706	95,080	----------	----------	----------	----------	953,786
Percent	90.0	10.0	----------	----------	----------	----------	100
California	4,739	----------	----------	----------	----------	----------	4,739
Percent	100	----------	----------	----------	----------	----------	100
Totals	2,109,059	228,961	7,719	----------	----------	----------	2,345,739
Percent	89.9	9.8	0.3	----------	----------	----------	100

TABLE 7.—POPULATION OF REGION 7 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
Maine	176,128	164,089	190,206	----------	141,331	125,669	797,423
Percent	22.1	20.6	23.8	----------	17.7	15.8	100
New Hampshire	199,113	266,180	----------	----------	----------	----------	465,293
Percent	42.8	57.2	----------	----------	----------	----------	100
Vermont	291,709	67,902	----------	----------	----------	----------	359,611
Percent	81.1	18.9	----------	----------	----------	----------	100
Massachusetts	170,312	899,539	1,432,964	1,705,863	40,936	----------	4,249,614
Percent	4.0	21.2	33.7	40.1	1.0	----------	100
Rhode Island	----------	----------	----------	687,497	----------	----------	687,497
Percent	----------	----------	----------	100	----------	----------	100
Connecticut	----------	82,556	1,405,381	118,966	----------	----------	1,606,903
Percent	----------	5.1	87.5	7.4	----------	----------	100
New York	365,118	1,538,033	1,251,600	4,547,775	4,724,485	161,055	12,588,066
Percent	2.9	12.2	10.0	36.1	37.5	1.3	100
New Jersey	----------	----------	----------	1,385,666	1,575,826	1,079,842	4,041,334
Percent	----------	----------	----------	34.3	39.0	26.7	100
Pennsylvania	290,409	1,118,466	2,876,566	706,400	1,610,043	3,029,466	9,631,350
Percent	3.0	11.6	29.9	7.3	16.7	31.5	100
Maryland	19,908	199,420	1,171,748	46,792	40,069	153,589	1,631,526
Percent	1.2	12.2	71.8	2.9	2.5	9.4	100
Delaware	----------	----------	----------	----------	161,032	77,348	238,380
Percent	----------	----------	----------	----------	67.6	32.4	100
Virginia	980,565	437,039	394,438	420,744	134,646	54,419	2,421,851
Percent	40.5	18.0	16.3	17.4	5.6	2.2	100
Wash., D. C.	----------	----------	486,869	----------	----------	----------	486,869
Percent	----------	----------	100	----------	----------	----------	100
Kentucky	716,876	886,947	856,791	28,511	----------	----------	2,489,125
Percent	28.8	35.6	34.4	1.2	----------	----------	100
West Virginia	568,403	628,872	503,419	153,975	----------	----------	1,854,669
Percent	30.7	33.9	27.1	8.3	----------	----------	100
Totals	3,778,541	6,289,043	10,569.982	9,802,189	8,428,368	4,681,388	43,549.511
Percent	8.7	14.4	24.3	22.5	19.4	10.7	100

TABLE 8.—POPULATION OF REGION 8 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
Oklahoma	54,080	204.670	247.711	568,539	165,069	87,091	1,327,160
Percent	4.1	15.4	18.7	42.8	12.4	6.6	100
Alabama	868,858	1,611,855	165,535	----------	----------	----------	2,646,248
Percent	32.8	60.9	6.3	----------	----------	----------	100
Arkansas	716,807	432,927	615,209	89,539	----------	----------	1,854,482
Percent	38.7	23.3	33.2	4.8	----------	----------	100
Florida	520,793	293,635	249,792	129,846	24,326	249,729	1,468,121
Percent	35.5	20.0	17.0	8.8	1.7	17.0	100

TABLE 8—Continued

Georgia	508,693	859,712	823,233	642,872	73,996	----------	2,908,506
Percent	17.5	29.6	28.3	22.1	2.5	----------	100
Louisiana	481,920	1,189,373	313,070	87,414	29,816	----------	2,101,593
Percent	22.9	56.6	14.9	4.2	1.4	----------	100
Mississippi	998,003	589,282	368,226	54,310	----------	----------	2,009,821
Percent	49.7	29.3	18.3	2.7	----------	----------	100
North Carolina	637,401	997,064	990,604	545,207	----------	----------	3,170,276
Percent	20.1	31.5	31.2	17.2	----------	----------	100
Tennessee	888,009	751,517	476,131	500,899	----------	----------	2,616,556
Percent	33.9	28.7	18.2	19.2	----------	----------	100
Texas	378,241	894,343	837,459	920,406	740,384	2,053,882	5,824,715
Percent	6.5	15.3	14.4	15.8	12.7	35.3	100
South Carolina	999,778	647,286	91,701	----------	----------	----------	1,738,765
Percent	57.5	37.2	5.3	----------	----------	----------	100
Totals	7,052,583	8,471,664	5,178,671	3,539,032	1,033,591	2,390,702	27,666,243
Percent	25.5	30.6	18.7	12.8	3.7	8.7	100

TABLE 9.—POPULATION OF REGION 9 BROKEN DOWN BY STATES AND COST-ZONES

	Cost of round trip to nearest national forest						
State	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-$20)	Zone 5 ($20-$25)	Zone 6 (Over $25)	Totals
Illinois	375,911	279,463	370,192	391,442	472,294	5,741,352	7,630,654
Percent	4.9	3.7	4.9	5.1	6.2	75.2	100
Indiana	17,853	160,752	139,897	865,049	1,026,799	1,028,153	3,238,503
Percent	0.6	5.0	4.3	26.7	31.7	31.7	100
Iowa	----------	----------	----------	----------	37,958	2,432,981	2,470,939
Percent	----------	----------	----------	----------	1.5	98.5	100
Michigan	921,601	481,751	807,159	640,534	1,991,280	----------	4,842,325
Percent	19.0	10.0	16.7	13.2	41.1	----------	100
Minnesota	317,205	150,956	293,089	1,166,066	292,710	343,927	2,563,953
Percent	12.4	5.9	11.4	45.5	11.4	13.4	100
Missouri	674,246	1,440,075	253,813	176,759	712,148	372,326	3,629,367
Percent	18.6	39.7	7.0	4.9	19.6	10.2	100
North Dakota	5,119	10,493	31,398	133,999	145,774	354,062	680,845
Percent	0.8	1.5	4.6	19.7	21.4	52.0	100
Ohio	----------	40,529	1,604,483	3,477,708	1,083,404	440,573	6,646,697
Percent	----------	0.6	24.2	52.3	16.3	6.6	100
Wisconsin	375,076	388,356	498,387	325,450	993,952	357,785	2,939,006
Percent	12.8	13.2	16.9	11.1	33.8	12.2	100
Totals	2,687,011	2,952,375	3,998,418	7,177,007	6,756,319	11,071,159	34,642,289
Percent	7.8	8.5	11.5	20.7	19.5	32.0	100

TABLE 10.—SHOWING BY NATIONAL FOREST REGIONS THE CUMULATIVE PERCENT OF POPULATION FALLING INTO SIX COST-ZONES ACCORDING TO THE COST OF A ROUND TRIP TO THE NEAREST NATIONAL FOREST

	Cost of round trip to nearest national forest					
Region	Zone 1 (0-$5)	Zone 2 ($5-$10)	Zone 3 ($10-$15)	Zone 4 ($15-20)	Zone 5 ($20-$25)	Zone 6 (Over $25)
			Cumulative percentage			
1	56	88	92	95	97	100
2	14	20	25	32	46	100
3	48	90	94	100	100	100
4	83	100	100	100	100	100
5	61	74	88	100	100	100
6	90	100	100	100	100	100
7	9	23	47	70	89	100
8	25	56	75	88	92	100
9	8	16	28	49	68	100
All Regions (Continental United States)	18	34	51	69	82	100

BRIEFER ARTICLES AND NOTES

Forestry Education: A Student Analysis

During these past four years, our every effort has been bent towards becoming active members of your profession and society. These four years of collegiate preparation naturally have intensified our initial desire to become foresters.

As contemporary undergraduates in one of the nation's largest forestry schools, we have had the opportunity of sharing complete intimacy with the warp and woof of a typical professional forestry school, namely, its students. Admittedly an educational institution is built around its students. Its facilities and faculty are there to serve, and to supply the demand which exists for the particular field of knowledge that they understand and teach.

Among students and educators there are two major points of view concerning educational methods. Some see the school as a great manufacturing plant consuming a very flexible raw material, the students, upon which it performs routine operations which lead to a rather uniform finished product. A certain portion of the raw material breaks down under the manufacturing process and is discarded.

Others maintain that a school should be operated upon the extractive or mining principle. Under this interpretation the school becomes a vein of valuable knowledge, to be dug into just as extensively as the student "miner" desires. He may scrape just enough from the surface to get by, but preferably he should be encouraged to sink his shaft both wide and deep. The immediate paradox is this: the student cannot be both the raw material of the first process and the miner of the second process.

Today's undergraduate forest schools are fundamentally manufacturing plants. They produce a limited variety of technicians upon a large scale. Within a given field they produce a certain percentage of high quality men. My classmates are questioning whether or not this present scheme of production is just what it should be. Their questions have been born of an awareness of conditions in the field today. Vision, not blindness, prompts their inquiry.

The following compilation of major educational issue which are now moot among students comes from the very best element of which any student body can boast: its top students and leaders. The chronic grumblings of the misfits and loafers have been filtered out. Only the legitimate issues are presented.

1. The fields of forestry knowledge have undergone rapid expansion. Does the present course of four years duration allow time enough to obtain sufficient information and background?

2. Competition for jobs indicates a need for quality, not quantity of production. To us this becomes a very serious and practical consideration.

3. Have not the professional demands changed since the birth of forestry? Is it still just the efficient technician who is needed to meet our problems? We believe that our present training has not equipped us to meet the many extra-technical problems which we must eventually solve.

4. Are field men walking encyclopedias? Or do they draw freely upon classified reference material? We believe that too much stress has been placed upon our ability to memorize pure factual data.

5. The courses which we enjoy most are those which involve thinking and the solution of problems. Why not employ this instructional method more extensively?

6. Graduate work is an outlet for individuality and advanced concentration upon students' special interests. Why are so many scholarships available in the fields of forest science, with so few available in the fields of forest economics and administration? Is not a student justified in his desire to pursue advanced work in these phases of forestry?

We have reviewed the literature which has appeared in the Journal of Forestry over the four-year period of our schooling. Here and there have appeared articles presented by professors and field men which state rather frankly

many facts confirming the legitimacy of the views held by the students today. A few have adopted their attitudes under the influence of such statements, but to most of us these questions arise as original and normal thoughts.

To many of us, our education has meant the investment of several hundreds of dollars and long hours of study and work, plus the cultivation of a sincerity of purpose in life. We feel that it is the duty of forest educators to give us our money's worth. There is an undercurrent of thought existent today which hints that our professional institutions may be holding out on us. If they are factories, then they have hastened our production too rapidly and are turning out men without certain essential parts. If they are mines, which we doubt, then their vein of knowledge must be exploited by more modern mining tools and methods, so that we may sink wider and deeper shafts.

We are not the educators, but the "educatees," if we may coin a new term for ourselves. We are seniors about to embark upon our professional work, and it is a bit too late to remould ourselves. But, in the sincere interest of those classes which must follow us, we would appreciate some light upon this problem which is so dark at present. That light can best take the form of active curricular change and improvement. We hope it will be forthcoming at an early date.

Howard E. Ball,[1]
New York State College of Forestry.

Planting Mallets: Their Construction and Use

The difficulty of obtaining consistently good planting of tree seedlings, especially in hard, packed, clay soils where mattocks must be used, is generally recognized. If the planting crews have had no previous experience as is commonly the case when C.C.C., W.P.A., or other relief labor is used, and if weather conditions are such that it is necessary for the men to wear gloves or mittens, it is almost impossible to obtain satisfactory planting results.

If they are required to plant bare handed, briars, stones, and mud make the work very disagreeable. Since men dislike to work under these circumstances, and if supervision is limited, packing usually is not properly done. In practically any planning crew men will be found using sticks, stones, or similar objects to tamp the soil. Trees set in this manner are usually more firmly planted and a better survival is secured than when the soil is tamped by hand.

As a result of some previous experience with planting mallets while with the Pennsylvania Department of Forests and Waters, the senior author suggested they be given a trial under Soil Conservation Service planting conditions. During the 1936 planting season the forester on the erosion control demonstration area at Lexington, N. C., had six rather crude mallets made. These proved to be such an improvement over old methods that an effort was made to produce enough mallets to equip all the planting crews. Changes in design and construction were gradually made, and during the 1937-38 planting season the details were worked out so that a satisfactory tool could be produced in quantities at a reasonable cost. This tool has proved to be the best type yet developed in this area to supplement the mattock in planting under the difficult conditions present.

Figure 1 shows a side view of two types of planting mallets. Type B is mallet recommended for general use. The materials necessary for its construction are a seasoned ash block (3 by 8 inches), a commercial hammer handle of hickory, two rivets, two washers, and one mowing machine section blade.

The block is turned on a lathe to a diameter of 2½ inches and slightly rounded on the blunt or hammer end. The other end is shaped as shown in the cut, and the blade riveted on. The blade should have a very slight downward angle toward the point. The handle is then fitted; it should be placed approximately one inch nearer the blunt end of the mallet to insure proper balance.

Type A mallet was designed for use where a lathe was not available for turning out the rounded heads, and at the cheapest possible cost of construction. The head is merely sawed

[1]Editor's Note: This brief note is based on a discussion of educational problems by a group of top-notch seniors at New York State College of Forestry. It is critical but temperate and fair. The Editor is especially happy to publish this statement. He hopes that it will stimulate further student and professional consideration of the problems of forestry education.

to shape as shown and fitted with a commercial hammer handle. This tool has a very limited use and the construction of the B type of mallet is advised where possible.

Various woods were tried for head construction, including dogwood, locust, hickory, oak, pine, ash, and others. Ash was found to be the most satisfactory to meet all conditions. The others had various faults, such as checking, splitting, too much weight, and rapid wear. The cost of materials for these mallets averages about 12 cents per mallet. A good mechanic should be able to construct a complete mallet in about 30 minutes.

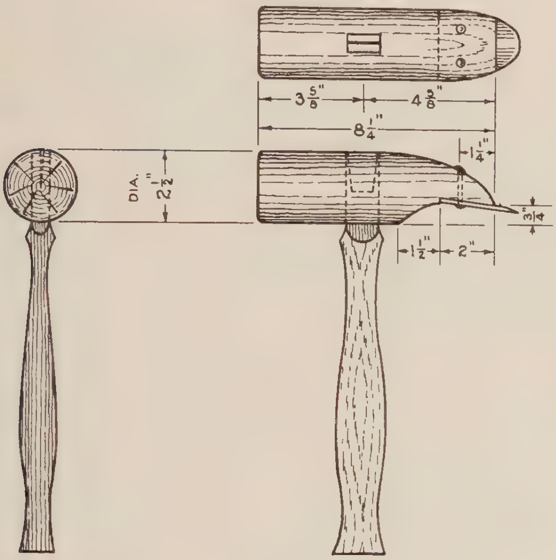

Fig. 1.—Planting mallet. The head is made of seasoned ash. The handle is a standard 14-inch carpenter's claw hammer handle. The blade is a standard fire rake or mowing machine blade.

This tool was designed for use by a regular two-man planting crew, where the mattock method of planting is used. The sharp end of the mallet may be used to enlarge the hole, or to dig additional dirt as is often necessary in rocky areas, or to cut away vegetation as is also necessary in areas with heavy grass or brush cover. In some soil types, with small planting stock, the mallet may be used to do the complete planting job. This is especially valuable where it is desired to use one-man crews for reinforcement planting, spot planting, or gully planting.

The tendency on the part of the average laborer is to do too much, rather than too little, tamping. The crew foreman can soon learn the technique and the time required to do the work properly in various soil and cover types. He should then be able to get uniformly good planting from the entire crew and eliminate useless effort and waste of time.

The use of this tool in heavy clay soils has produced a uniformly higher survival than where the other planting methods were employed. Planting costs may be appreciably lowered by the increased speed of planting. New planting crews are more quickly trained to do good work and require less direct supervision. This is especially noticeable where difficult planting conditions are encountered, such as wet, cold weather, briars, rocky ground, and similar conditions that make hand tamping disagreeable. The planters who have used this mallet are unanimous in their approval of the tool under the conditions mentioned above.

Ralph B. Heberling and Carl D. Fetzer,
Soil Conservation Service.

A New Alder

Alnus rubra Bong. *pinnatisecta* var. nov.

In the spring of 1938 T. Norman Nelson called to my attention an alder tree[1] growing on his farm, sixteen miles northwest of Portland, Ore., by way of the St. John's Bridge. Last fall upon visiting the farm seven different trees were discovered, varying in height from 2 to 15 feet. In all cases the trees bore leaves of a particular outline which were cleft almost to the midrib. This type of leaf is uniform throughout the crown. These trees are growing intermixed with great numbers of red alder trees bearing regular leaves. The trees appeared vigorous and the larger ones were producing fruit. Catkins, bark, and other characteristics except leaves and fruit are similar to red alder. These characteristics are shown in Figure 1. Two European alders, *A. glutinosa* and *A. incana,* have similar varietal forms.

Alnus rubra Bong. *pinnatisecta* var. nov.

Foliis subtus minute puberulis, prope nervo medio, vel eo tenus, pinnatifidis, marginibus plus

[1]Since preparing this note my attention has been called to an alder of similar cut-leaf structure growing near Mt. Adams, Wash. I have not, however, seen this specimen.

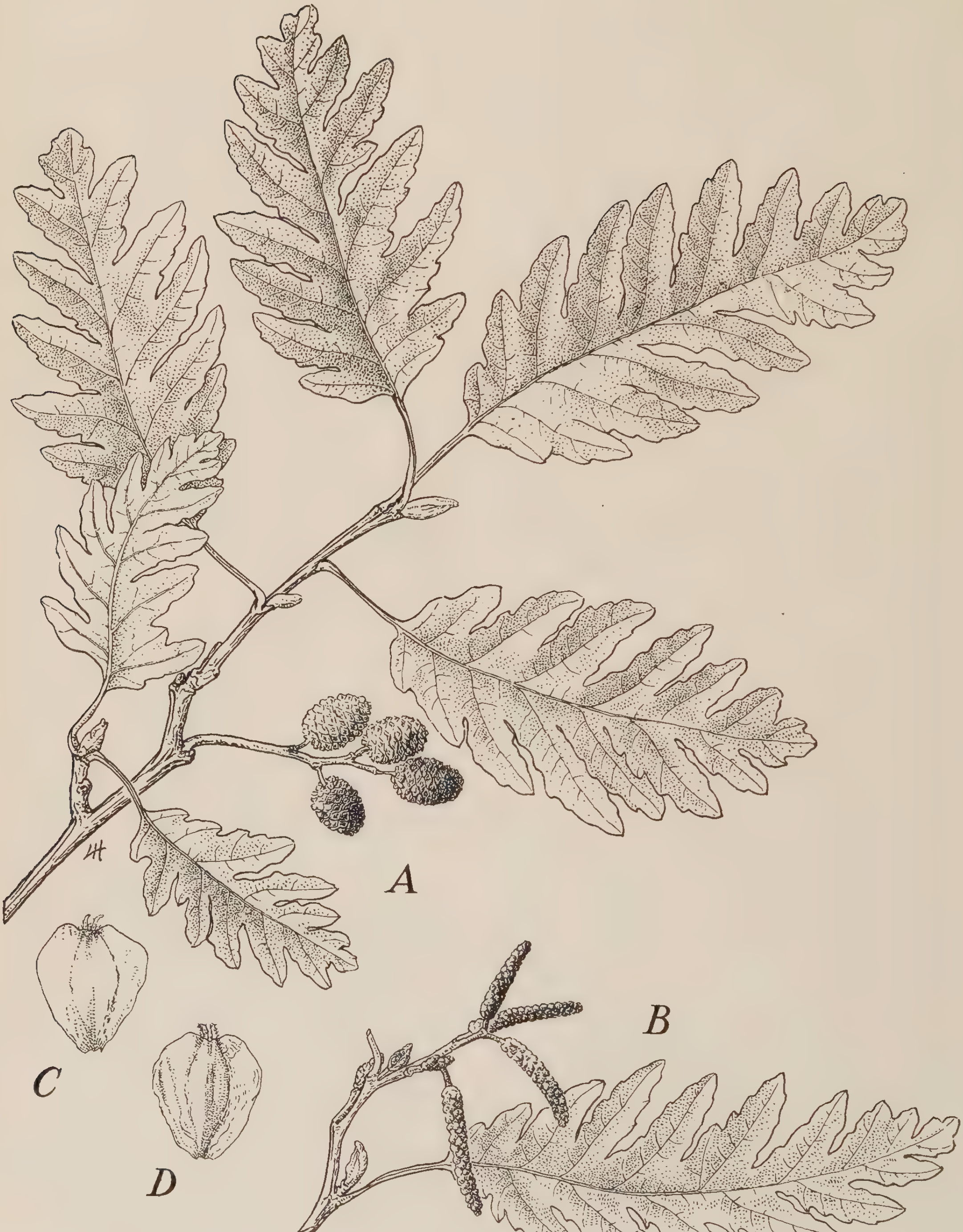

Fig. 1.—*Alnus rubra* Bong. *pinnatisecta* var. nov. Branch taken in September showing pinnatifid leaves, almost mature fruits, and new staminate flowers. (Drawing by Miss Leta Hughey, U. S. Forest Service.)

minusve serratis vel dentatis; conis fere ellipsoideis, ad apicem minime attenuatis.

Leaves minutely pubescent beneath, pinnately dissected nearly, or quite to the midrib, the margins more or less serrate to dentate; comes nearly ellipsoid, only slightly narrowed at apex.

T. J. Starker,
Oregon State College.

Errors in Age Counts of Suppressed Trees

To most foresters the botanical textbook statement that trees of the north temperate zone customarily produce a layer of wood during the growing season of each year is a truism. We usually accept without question this record, written in annual growth rings by the tree, as accurately revealing the total number of years during which it grew. It is therefore something of a shock to realize the extent to which trees under certain forest conditions prove to be exceptions to this rule. Recent studies by the Allegheny Forest Experiment Station[1] have shown that basal sections of suppressed hemlock, beech, and even white pine may fail to show evidence of annual ring formation during protracted periods.

In the course of these studies a series of 10 sample plots, of one acre each, was established in various stand and topographic conditions within a virgin hemlock-beech and white pine-hemlock forest on 2,000 acres, about to be logged. This forest is located on East Tionesta Creek within the Allegheny National Forest in northwestern Pennsylvania. On these plots all trees 0.6 inches d.b.h. and larger were mapped, individually described, and cross sections or similar material were collected for later laboratory counts of the total age of each tree. As the area was being logged, it was possible to obtain basal disks of all small trees at ground level, and to saw disks, or V-shaped sections along a radius, from the tops of stumps.

Most of these sections could be counted after having been surfaced on several sanding disks and a grinding wheel.[2] However, growth characteristics and qualities of the wood of the different species required special treatments in certain cases. Hemlock, even when greatly suppressed, could always be counted, when well-surfaced, because of the strong contrast between spring and summerwood. Hardwoods were more of a problem because of lesser contrast between the spring and summerwood in most species, but the use of phloroglucinol stain on a smooth cross-section generally overcame this difficulty. Very finely suppressed beech required the staining of a thin cross-section shaved off with a sharp knife. A binocular microscope with 20x magnification was used for the counting. This power was satisfactory for all except the most finely suppressed pieces of beech, which required a 30x magnification.

Total age of each tree—a number of annual rings on the stump, plus number of years required to reach stump height—was to be determined by application to the stump ring counts of corrections obtained from a study of seedling growth rates. Analysis of the seedling data proved accurate corrections to be impossible. The variation in age required by seedlings to reach stump height was too great to permit the use of an average figure, and a division of the data into three classes, based on rate of initial diameter growth, was also unsatisfactory. This necessitated obtaining the total ages by re-cutting all stumps at or near ground level.

But even this process did not yield accurate age counts in suppressed or very slow-grown trees, because some rings were missing. The problem of missing rings was first encountered in the seedling analyses. When ages were counted in each seedling at the base and at one-foot intervals up the stem, it was found that in greatly suppressed individuals the number of annual rings at a particular height was less than the true age as obtained by a count of the terminal bud scars above it. Obviously rings had not been produced over the whole of the stem in certain years.

The phenomenon of missing rings was later encountered in the counting of certain basal sections. The number of rings on a section taken at a two-foot stump height was sometimes greater than on a section cut at ground level. This occurred only if there had been a period

[1]Maintained at Philadelphia, Pa., in cooperation with the University of Pennsylvania.

[2]Hough, A. F. A method of preparing wood sections for accurate age counts. Jour. Forestry 33:698-699. 1935.

during which the growth of the tree was greatly suppressed. During a long period of suppression, the food manufactured in the crown is in certain years not enough to form a sheath the entire length of the bole. Glock[3] has found that in ponderosa pine accretion more often fails to take place near the crown or near the base than at mid-tree.

The most striking evidence of missing rings was obtained from hemlocks and hardwoods which on one plot had, as very small, slow-grown trees, survived a severe blow-down in 1812. Released temporarily, these individuals suddenly increased their diameter growth during several decades. White pine seeded into the windthrown stand, and after several decades the hemlocks and hardwoods were again suppressed, as were the feebler pines. A large number of the pines, however, showed no evidence of suppression, and close agreement between their juvenile ring sequence[4] and those of the hemlocks and hardwoods immediately following the latter's release proved that they originated within a year or two of the blowdown, the date of which was thus established by their total age. The rings missing from basal sections of the hemlocks and hardwoods were omitted from the last 70 years of the 123 years since the catastrophe. The maximum number was 46, in a beech 3.4 inches d.b.h.; in a hemlock, 39. One suppressed white pine formed no visible ring at ground level in 28 of the more recent of its 122 years.

H. W. Turberville and A. F. Hough,
Allegheny Forest Experiment Station.

[3]Glock Waldo S. Principles and methods of tree-ring analysis. Carnegie Inst. Wash. Pub. 486. 1937.

[4]The cross-identification of ring sequences was employed by Douglass in dating timbers cut by the cliff dwellers of the Southwest, and by other investigators of tree growth. Douglass found that certain easily recognizable sequences in the annual rings—one or more conspicuously narrow rings among relatively wide ones, for example—occurred again and again in cross-sections of trees from a single locality, and could be used as a reference datum in age counts.

Further Comments on Yield Tables for Southern Pines[1]

Review of the comments by F. X. Schumacher on this subject seems appropriate because of the importance of securing reliable yield tables for southern pine. This professional objective should have more weight than controversies over prestige or efforts to discredit the work of any agency.

The test of reliability of a yield table is its dependability as a means of predicting growth of even-aged stands. Yield tables universally are based on the premise of securing fully stocked stands *at all ages.* Due to the variables involved, it is impossible to set up or to obtain mathematical perfection in such a task. Hence judgment enters into the process of selecting these stands in the field, and the results of projects carried on independently may well differ. These differences may be due, first, to the conception of normal stocking held by the respective agencies or parties; second, to the degree of exclusion or rigidity of selection employed; and third, to the size of the plots. The last factor is controlled by basing plot size on a standard range in the number of trees they should contain, thus increasing the size with the age of the stand. By the exercise of "high" standards it is quite possible that results may be obtained giving yields as much as 33 percent greater than if larger plots, or plots representing a greater percentage of the total stands are used, but such large differences are unusual. The writer in 1903 was in charge of a project (conducted by U. S. Forest Service personnel) for making a yield table of jack pine in Minnesota. Recently the Lake States Forest Experiment Station completed a yield table for the same species, showing appreciably higher yields per acre. The writer has not considered this published result as any reflection on his professional ability, nor requested a "comparison" of standards and methods used, in order to "harmonize" the results, though such a comparison might have been in order if the two studies had been conducted simultaneously.

The value of a yield table is not determined by its standard of exclusiveness in selection, but by the relation of its curves of growth to those that can be expected in actual production of timber crops. Understocked stands, if no destructive agencies affect them, tend to increase their percentage of stocking, and this factor

[1]See: Sylvester, W. A. A comparison of two methods of yield table construction (with a prefatory note by H. H. Chapman) and comments by F. X. Schumacher. Jour. Forestry 38:681-686. 1938.

serves to offset inevitable losses from wind and insects. With stands in the mature stage, especially in southern pines, the constant operation of Dendroctonus, taking a tree here and there, and occasional loss from individual windthrow, makes it practically impossible to expect even in understocked stands, much less in fully stocked areas, a maintenance to 80 years of full stocking judged by any criterion. The selection of "fully stocked" stands at all ages then means that the percentage of the total area occupied by the age class which is represented by this degree of stocking constantly decreases. This fact would finally be established, in yield tables, by permanent sample plots, remeasured over a period of 20 to 30 years.

Since the amount of such "endemic" or normal losses cannot yet be judged due to lack of such data, the standard of "normal" stocking for the older age classes has been adhered to as far as known in all yield table projects, including both of those under discussion. But should it happen, for any reason, that the *trend* of the curves of a yield table do not coincide with observed experience, even when deductions are made for relative density, and when the results of a second and subsequent study bear out this discrepancy, the burden of proof as to the accuracy of the original table would seem to rest on its authors.

Certain comments by Mr. Schumacher are treated below:

(1) "Mr. Sylvester reports that the study is based upon loblolly pine! There is no vestige of 'accompanying yield tables for longleaf and shortleaf pines.'"

Quote from article, "It would seem that these yield tables for southern pine in Miscellaneous Publication No. 50 of the U. S. Dept. Agriculture should be promptly revised by proper statistical methods, and in the meantime withdrawn from circulation, especially as *the accompanying tables* for longleaf and shortleaf pine show similar tendencies." The tables thus referred to are contained in the above quoted publication.

(2) Heavier normal stocking "is not a sufficient reason to withdraw the earlier tables. . . . Significant differences among the collections of different men are the rule rather than the exception."

Had the trends of the two sets of curves been similar, this point would have much weight and the two tables would have practically equal value in prediction of yields since either could be discounted for actual stocking. The sharp diversion of the older curves from the more recent, and in the direction of constantly higher yields at the ages desired for prediction, requires an inevitable choice as to the relative reliability of the respective tables.

(3) Standards of measurement used. The volume table used in the new table, and presumably in the old, is found as Table 5, Misc. Pub. No. 50, page 23, giving top diameters to 5 inches, stumps 1 foot.

(a) The yields were calculated by the International ⅛ inch rule from the above table. Both tables were then reduced to terms of the ¼ inch rule, since the latter is more serviceable as a measure of output from the average southern mill than the former. The comparison, in percentage, is of course the same.

(b) The stand measured for board feet included all trees 7 inches and over in both cases.

(c) No evidence is given in the older table as to numerical basis and distribution of plots or areas covered by the data, as is now customary. The basis, 238 plots, for the more recent table is mentioned, but its distribution was omitted, as the article under consideration was merely intended to call attention to the comparison. The data are shown in Table 1.

TABLE 1.—NUMERICAL BASIS AND DISTRIBUTION OF PLOTS USED IN CONSTRUCTING LOBLOLLY PINE YIELD TABLE

Age class	80 feet Number	90 feet Number	100 feet Number	110 feet Number	Total
20	2	2	1	2	7
25	7	8	3	1	19
30	1	5	3	2	11
35	2	8	2	----	12
40	4	15	8	1	28
45	8	34	6	1	49
50	7	9	7	2	25
55	8	16	6	2	32
60	3	17	7	1	28
65	1	8	13	----	22
70	2	1	2	----	5
Total	45	123	58	12	238

(d) Every plot taken was personally supervised and the technique standardized by the same man (the writer) throughout, including the selection of the dominant stand. It is not thought that differences in selecting the dominant stand, which would offset slightly the position but not the divergent trends of the curves, could account for these comparative results.

(e) Ten years of subsequent investigations

were considered necessary in order to extend the curves to the 60, 65, and 70-year age classes where the most serious doubt arose, as well as to strengthen the numerical basis of other age classes. This project did not have the use of any funds whatever, either for travel or hire of labor, in order to seek out these older stands elsewhere, so we had to let them *grow* to the ages desired. Comparisons or questions as to the relative reliability of the studies were not in order until a sufficient factual basis was secured.

(f) The Southern Forest Experiment Station in its annual report for 1937 states as one of its projects "all previous growth and yield studies for the southern region will be reviewed."

(4) Since Mr. Schumacher is far better equipped as a statistical expert than the writer, the latter will not attempt to discuss his comments on the test of the former's method with the older standard graphic method of yield table construction. The relative values obtained by the two methods are shown, and the fact is reiterated that it took three times as long by the former as by the latter method to construct the tables. If it is true that the differences in the old yield table and that recently presented may possibly be explained solely by "significant differences among the collections of different men," it would seem to be straining at a gnat to seek expensive refinements in office methods, whose differences in results appeared in this test to be trivial in comparison with those of the original and recent tables.

I still feel that the reliability of yield tables for the southern pines, in view of the immense area affected, is extremely important, and that the original published tables are unreliable as to yields in the upper brackets and that they should be withdrawn and revised as promptly as possible, if at this date, material of the older age classes of second growth can still be found in sufficient quantity to give a reliable factual basis for such a revision.

Our conclusion, based on 30 years of observation, is that normal yields of the southern pines tend to flatten out, not only in basal area, which seldom exceeds the average maximum of 150 square feet attained at about 50 years, but in board feet as well. A yield of 30,000 board feet for site index 90 is a rough criterion of the attainable maximum for loblolly pine, and longleaf pine appears to adhere closely to this general trend. Probably the limiting factors which bring about this cessation of rapid growth in volume are those of soil moisture and occasional droughts, accompanied by increasing intolerance and the advantage possessed by dominants in the root struggle for this moisture. These relationships have an important influence on thinning practices in young stands and indicate that at a height of about 35 feet 50 percent of the crown canopy should be removed. When this was done, in loblolly pine, the crowns closed within 5 years.

H. H. Chapman,
Yale University.

Table Mountain Pine—Squirrel Food or Timber Tree?

The proper or preferred menu for our furred and feathered friends—and victims—is today a leading question for our ecologists and game specialists. Many old standbys are known, but from time to time a new fruit or browse comes to notice, and these are often of great importance. Their neglect has in many cases been due to their occurrence in out-of-the-way places, where conditions are unfavorable to the more well-known foods.

In 1935, in Huntington, Pa., the writer became interested in a tree which has received little, if any, attention by foresters: namely, Table Mountain pine (*Pinus pungens* Lang). Originally named by Michaux for its occurrence in considerable numbers on Table Mountain, North Carolina, it is found throughout central and eastern Pennsylvania, usually along dry ridge tops, on poorer soils, and on south-facing slopes. The occurrence of heavy limbs and a scrubby appearance are considered by Illick,[1] and others, as characteristic of this species.

During the severe winter of 1935-6, and for two subsequent years, observations led to the belief that these characteristics may be purely ecological in their origin and a result of external influences. The explanation is probably found in two striking phenomena which indicated that the Table Mountain pine does not fare as its associates, the northern white (*P. strobus*), the Virginia scrub (*P. virginiana*), or the pitch pine (*P. rigida*). Under every Table Mountain pine there was a heavy litter

[1]Illick, J. S. Pennsylvania trees. 1928.

Fig. 1.—Typical squirrel pruning of a young Table Mountain pine. Note that almost all limbs, including the leader, have been clipped and that cones located where the limb is over one inch in diameter have not been removed.

of branch stubs and cone scales, so noticeable that one could identify this species merely by looking at the ground. None of the other previously mentioned pines had similar litter at their bases. The other obvious difference was an appearance of having been pruned, which was the actual case, as from 50 to 100 percent of the limbs were clipped back. Comparison of the branch stubs on the ground with these clipped limbs showed that in every case they had been gnawed through by red squirrels (*Sciurus hudsonicus*).

Obviously the purpose is to drop the sessile and heavily prickled cones—which usually occur in whorls around branches of the previous year's growth—to the ground, where they can be easily opened. The occurrence of the cones in whorls is probably the cause of this pruning, as it is difficult for even such a trapeze artist as the squirrel to find a point at which a single cone can be easily severed; and further, his reward is greater, as he obtains several cones for each operation. However, regardless of the reason for the practice, it obviously has a very marked effect on the growth and form of the tree. The stubs on the trees examined never exceeded one inch in diameter, and this would seem to be the diameter class beyond which the law of diminishing returns becomes operative.

That the squirrels did not, as was at first suspected, consider it an "ersatz" food during an exceptionally hard winter, is proven by continuing observations. It is further interesting to note that Table Mountain pine is known to local inhabitants as "squirrel pine," a term which, unlike many colloquial names for other species, it shares with no other tree and which neither Sudworth nor Illick has included in its description.

The writer has seen specimens of good size and form, and is of the opinion that were it not for the assiduous attention of the squirrels, this species might be as valuable a timber tree as pitch pine. But as long as we have squirrels, it is probable, and possibly desirable, that the Table Mountain pine must rest content in its humble role as commissary for these inhabitants of the forest and leave to its relatives with less palatable seed the part of lily of the commercial field.

If our observations are further confirmed by others, Table Mountain pine should be added to our preferred list of game food trees, particularly since it can be planted on dry slopes and other unfavorable sites where many other species will not survive as well.

Wm. Mollenhauer, Jr.,
Allegheny Forest Experiment Station.[2]

The Use of "Gooseneck" and Six's Thermometers for Measuring Soil Temperature

Soil temperature at the surface and at varying depths below is recognized as a factor which may influence the germination, survival, and growth of plants. Soil temperature below the freezing point may also greatly reduce the water absorbing capacity of the soil thus resulting in increased run-off and subsequent erosion and floods.

To measure this important factor several types of thermometers are commonly used. Among these are the so-called "gooseneck" maximum and minimum thermometers employed

[2]Maintained by the U. S. Department of Agriculture at Philadelphia, Pa., in cooperation with the University of Pennsylvania.

to determine soil surface temperature, and a Six's type maximum and minimum thermometer, first used by Gemmer[1] to measure temperature below the soil surface. Both types have been used by the Allegheny Forest Experiment Station,[2] and although the gooseneck minimum is

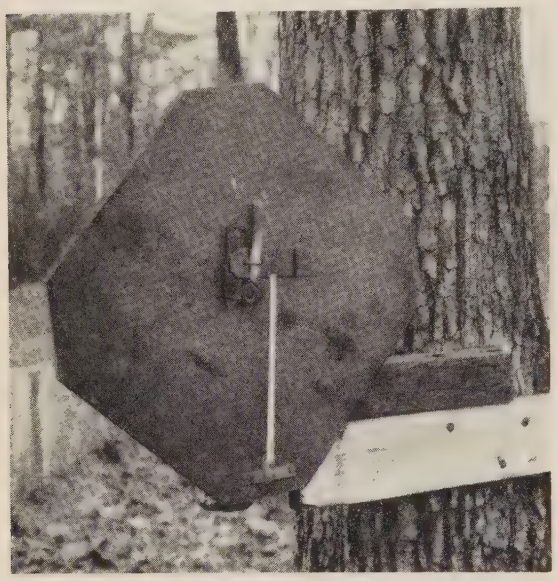

Fig. 1.—Thermometer in place in the centrifuging device ready to be whirled.

fairly efficient the gooseneck maximum and the Six's type have certain inherent defects. The purpose of this note is to describe measures used to overcome these defects.

Our gooseneck maximum thermometers were accurate enough, but it was extremely difficult to return the mercury to the current temperature after a high reading. This is normally done by shaking, but even violently shaking our instruments was ineffective. Hence the device shown in Figures 1 and 2 was used. The grinding wheel was removed from an ordinary bench tool-grinder and in its place was bolted the board shown in the figures. A small notch to accommodate the bulb of the thermometer was cut in the board near one of the outer corners. A small strip of tin, nailed over this notch, made a snug pocket. Just above the center of the board a small hasp and staple were fixed, a groove having previously been bent in the hasp so that it fitted loosely over the stem of the thermometer when closed. A piece of inner tube was tacked on one side of the staple to provide a cushion when the hasp was pinned down.

The refractory thermometer could be quickly fitted into the notch and the hasp pinned down, as shown in Figure 1. A few turns of the crank would then centrifuge the mercury back to the current temperature.

The Six's thermometers used for recording subsurface temperatures were about 5 inches longer over all than those used by Gemmer. They are American made[3] and have a scale reading from 0° to 180° F. The chief objection to these instruments is their extreme fragility. Great care must be used in placing them and their use would not be recommended in any but rock-free soils. Once in place, however, they have given us an accurate, year-long record.

In order to place these fragile instruments with safety and in undisturbed soil, a pit 12 inches wide, 32 inches long, and about 24 inches deep, having perpendicular walls and square corners, was carefully dug. See Figure 3. Into one end of this pit, a box 12 inches wide, 12 inches long, and 24 inches deep, open at the bottom and having a hinged lid, was carefully placed so that three of its sides fitted snugly against three sides of the pit. Holes

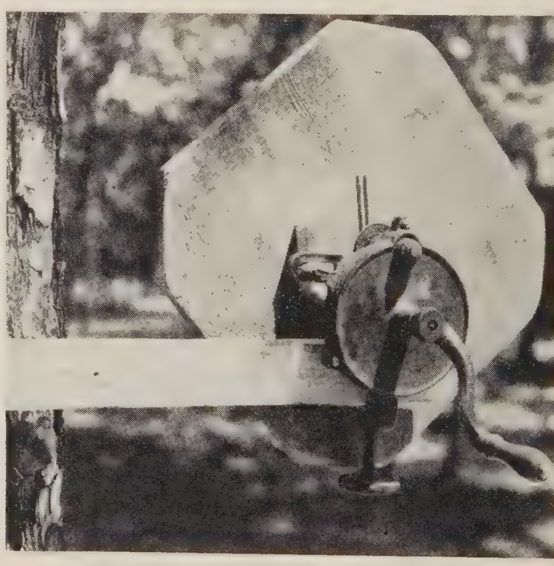

Fig. 2.—Rear view of centrifuging device.

[1]Gemmer, E. W., Jr. A method of recording maximum and minimum temperatures of forest soils. Science 70:505-506.

[2]Maintained by the U. S. Department of Agriculture at Philadelphia, Pa., in cooperation with the University of Pennsylvania.

[3]Precision Instrument Company, Philadelphia, Pa.

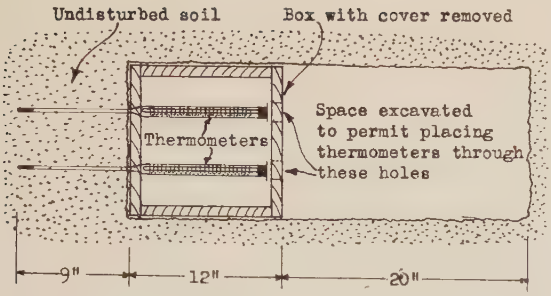

Fig. 3.—Top view of thermometers as placed in boxed pit.

6 and 12 inches below what was to be the ground level had previously been bored in two opposite sides of the box. The box was so placed that these holes were exactly 6 and 12 inches below the soil surface and a line through each opposite pair was parallel with the long dimension of the pit. The box was then wedged in place to prevent further movement. Following this operation, an iron rod, slightly larger in diameter than the thermometer bulb stem, was driven on a line parallel with the soil surface, through each opposite pair of holes in the box, into the soil to a depth of 9 inches, the length of the bulb stem. The rod was then withdrawn and the thermometer carefully inserted through the holes and into this prepared channel in the soil. The end of the thermometer opposite the bulb was supported inside the box with a loop of wire.

With the bulbs thus in place in undisturbed soil, the two unoccupied holes in the side of the box were plugged and the excavation filled by packing soil against the fourth side of the box. Readings were then made as desired. The hinged cover may be locked to protect the instruments.

O. M. Wood,
Allegheny Forest Experiment Station.

A Sign that Tells a Story

There has been a long felt need in forestry demonstration and research work for a sign that will tell a story, and one that can also be conveniently kept up to date. The sign illustrated in Figure 1 was designed by the author to meet this need. It embodies a double construction with a weather proof compartment inside where detailed information can be posted. The face of the sign, which contains general information, is hinged to the back; the weather proof compartment inside, which contains the data, is exposed by lifting the face of the sign as shown in the picture. It should be mounted on the post in such a manner that the front, when lifted, will tilt slightly forward so that it will fall shut and remain closed when released.

Maps of sample areas, charts, graphs, or one-page summaries of results can be posted inside and renewed when desirable. The sign has been found particularly satisfactory for plantations, growth and yield studies, stand improvement areas, and reproduction plots, and should find many other uses where it is desirable to post detailed information for visitors. The type now in use has space inside for three lettersize sheets.

Leo A. Isaac,
Pacific Northwest Forest Experiment Station.

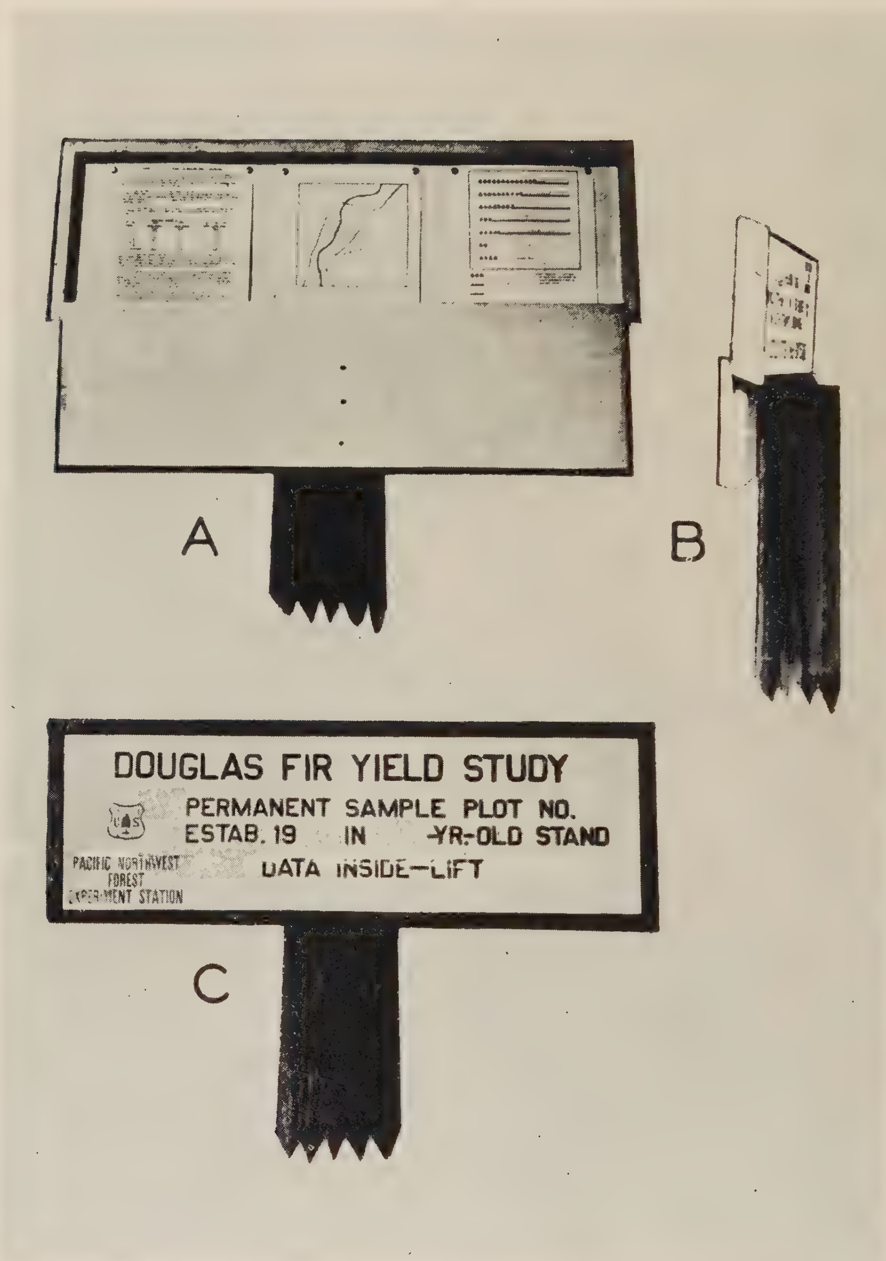

Fig. 1.—A. Front view of the sign opened, showing current data mounted in the compartment. B. End view of the sign opened, illustrating how the sign is mounted on the post. C. The sign in its natural closed position.

REVIEWS

Poisonous Plants of the United States. By Walter Conrad Muenscher. *xvii+266 pp. Illus. The Macmillan Company, New York. 1939. $3.50.*

It comes as a surprise to realize that more than 25 years have passed since Pammel's *Manual of Poisonous Plants* was published in 1911 and that no general treatment of the poisonous plants of the United States has appeared since then. So much has been added to our knowledge of poisonous plants during the intervening period that the issuance of the present volume is timely indeed. A commendable attempt has been made to include results of recent experiments. Of the 232 literature references, 194 have been published since 1911. As examples of contributions in the past quarter century, the whole field of selenium poisoning has been opened up and numerous species hitherto unreported, such as *Drymaria holosteoides,* have been found poisonous.

The book is divided into two parts: (I) nature and classification of poisonous plants, and (II) detailed information and arrangement according to family. Part I is brief, but to the point, with a discussion of chemical nature, toxic principles, physiological action, conditions of poisoning, etc. It also briefly presents special conditions under which plants may cause difficulty, such as dermatitis, photosensitization, selenium poisoning, mechanical injury, etc. These first 18 pages furnish an unusually compact working knowledge of fundamentals of plant poisoning.

Part II is 220 pages of detailed information regarding some 400 individual species representing 68 families of vascular plants, arranged in general according to the Engler system. Profusely illustrated with line drawings, the book presents information concerning each of the more important plants under the following headings: description, distribution and habitat, poisonous principle, conditions of poisoning, symptoms and treatment. Species very similar in effect are treated together, and less important plants are usually summed up in a pointed paragraph.

Having developed through the years from mimeographed reading outlines used in classes at Columbia University, the book is admirably suited for use as a text in college courses or other study of poisonous plants, applicable to the entire country.

It is a valuable reference for range managers and research workers and others having to deal with vascular plants poisonous to livestock, wildlife, and man.

The index appears to be complete and usable.

R. S. Campbell,
U. S. Forest Service.

Der Wald (The Forest). By Richard B. Hilf. *290 pp. Illus. Akademische Verlagsgesellschaft Athenaion, Potsdam. 1938. Pr. RM 22.40.*

Hilf's book is a most interesting account of the German forest and its influence on German culture from prehistoric times almost to the present.

It begins with a brief discussion of the forests before the appearance of man. At one time *Araucaria, Sequoia, Thuja, Taxodium* species and palms were abundant, along with many of the genera occurring in Europe today. The amber deposits of the Baltic coast are fossil resin from *Picea engleri,* which flourished during the Oligocene period.

Considerable space is devoted to the long period of primitive utilization of the forest and its products, which began with palaeolithic man (long before 30,000 B. C.) and continued through the neolithic, bronze, and iron ages to medieval times. During most of this period man lived in and from the forest. He was a part of the forest environment, a form of wildlife, just like any of the forest animals. He did not materially modify the extent or composition of the forest until well into the historic period. Pollen investigations, however, show that climatic and geological changes were accompanied by many

changes in the composition of the forest, independent of human interference. Later, as the population grew and became sedentary, the forest was both an obstacle to settlement and an indispensable source of materials for domestic and industrial use. Medieval methods of utilization are described at considerable length.

Toward the end of the Middle Ages—somewhere between 1350 and 1500 A. D.—began a period of conflict between unrestricted exploitation and regulated use of the forest, which continued until the end of the eighteenth century. This was a period of growing demands on the forest, accompanied by local shortages. It was marked by devastating wars (especially the Thirty Years War) and far-reaching political and social changes, and by a growing tendency for the states to regulate and restrict the use of the forest so as to prevent its destruction. A woodcut from this period (about 1700) depicting the felling of a huge fir by choppers standing on a scaffold some 15 feet above the ground suggests that German lumbermen at one time cut stumps as high as any in our West Coast forests.

The latest period, from about 1800 to the present, is characterized by the development of sustained-yield forestry. Hilf devotes less space to this section than to the others, possibly because it has been adequately covered by other authors. Only 13 lines are given to events since 1933.

The book is profusely illustrated with diagrams and reproductions of photographs, old woodcuts, maps, tapestries, and paintings. It is to be commended not only as a piece of historical research but also for its artistic excellence.

W. N. Sparhawk.

Tree Growth. By Daniel T. MacDougal. *240 pp. Illus. Chronica Botanica Co. Leiden (Holland) and G. E. Stechert, New York. 1938. Pr. 7 guilders or about $4.*

This book deals mainly with tree growth as revealed by dendrographic records and readings of dendrometers. Most of the experiments described were carried out during the past 22 years by the author, at the Desert Laboratory, Tucson, Ariz., and at the Coastal Laboratory, Carmel, Calif.

The author first considers the fact that living trees expand in diameter at night and contract in the daytime, with daily variations in diameter of 0.3 to 3 percent. Early workers had explained the reduction in elongation and diameter growth by postulating that light inhibits growth. MacDougal points out that shrinkage in stems is due to inadequate moisture supply because it begins when the stomata open at daybreak; ceases soon after they close in late afternoon; is large on warm, windy days and small on rainy days; and disappears from trees heavily top-pruned or defoliated. A seasonal shrinkage in dry summers and swelling in late autumn also depend on water supply. Dead trees and even poles show daily fluctuations in diameter caused by interchange of moisture with the air, but these variations are only about 2.5 percent as large as those in living trees.

Diameter growth of Monterey and other pines was found to begin in spring when cambial temperatures reached 8°-12° C. Growth sometimes began at the same time throughout the trunk and crown; at other times it began irregularly. Removal of buds impeded development of tracheids, indicating that the buds furnish some elements required for normal cambial activity, probably hormones or growth substances. The author feels that too few studies have been made of hormones in trees to form a sound basis for interpretation of all growth phenomena. At Carmel the Monterey pine sometimes grows in diameter throughout the year, without interruption; ordinarily, however, growth ceases in summer when the soil is dry and in January or February when temperatures are low. Irrigation of quiescent trees in midsummer caused an immediate resumption of growth. Once awakened, cambial activity continued until interrupted by low temperature or depletion of soil moisture, but elongation of stems ceased before either of these factors became unfavorable for diameter growth.

From growth records on trees of different ages MacDougal pieced together a record corresponding to that made by a single Monterey pine throughout its life. The total leaf surface and the efficiency of this surface in producing wood were computed for various ages. Efficiency was greatest in trees 9 to 11 years of age, which produced enough wood to cover the entire leaf surface to a depth of 1 mm. In old trees production was sufficient to form a layer of only 0.1 mm. MacDougal attributes the decrease in efficiency of leaf area of old trees to the greater energy utilized in lifting water to the crown, and to the greater difficulty in translocating material from

leaves to the base of the trunk and the ends of the roots. He postulates that this may be a dominant factor in limiting the size or height of the tree. He does not mention that decreased efficiency of leaf surface is probably due also to mutual shading. The leaf area of a 50-year-old tree was 12 times the area of the vertical crown projection.

Growth of the two California Sequoias is presented in great detail. This was found to be similarly related to temperature and soil moisture. Redwoods in soil watered by springs grew faster in drought years, when average temperature and light intensities were greater.

In other chapters, the growth of bald cypress, larches, spruces, Douglas fir, Monterey cypress, ashes, elms, maples, beech, sycamore, oaks, walnut, poplars, willow, California laurel, madrone, horsebean, palo verde, umbu, and tree cactus is portrayed. Growth of most of these, also, was found to depend upon adequate soil moisture and a minimum temperature of 8° to 11° C. The growing period of many species, especially those native to the same latitude, was lengthened a month or more by transplanting them from dry or cold regions to Carmel, where the temperature is favorable for growth throughout the year. However, continuous growth rarely occurred in such species, perhaps, though not mentioned by MacDougal, because of the shortness of winter days. The highly xerophilous palo verde proved to be an exceedingly slow grower. One tree, according to the record, had at the end of a 5-year period a diameter 3.36 mm. less than it had at the start.

Dendrographic records of root growth are also reported.

The book contains few generalizations and no carefully organized summaries to guide the reader through the great mass of detailed descriptions of bi-weekly growth of individual trees. These growth records, which take up a large part of the text, are often presented as complete in themselves, with no attempt to relate them to external or internal growth factors. *Tree Growth* will be of interest to foresters specializing in mensuration and to tree physiologists; but the average forester will probably find it tedious to read and difficult to assimilate.

HARDY L. SHIRLEY,
Lake States Forest Experiment Station.

Plant Growth-Substances. Their Chemistry and Applications, with special Reference to Synthetics. By Hugh Nicol. *xii+108 pp. Illus. Leonard Hill, Ltd., London, and Chemical Publishing Co. of New York. Inc. 1938. $2.*

Those wishing a general introduction to the history and development of that phase of physiological research dealing with plant growth-substances would do well to read this interesting book. It is readily understandable by the layman, yet treats of the more technical aspects of interest to chemists and physiologists. The numerous references to published books and papers, while not exhaustive in scope, will allow one to delve more deeply into any phases of the subject in which he is most interested.

Foresters, for the most part, will probably be interested in some of the present-day conceptions of what makes herbaceous plants and trees respond to the various stimuli of environment in such ways as bending toward the light, transition from growth to reproductive phases, and dominance of terminal shoots. Though these factors have not yet been fully demonstrated, preliminary evidence points the way to further correlations between these phenomena and growth-substances. The practical application of synthetic growth-substances is being demonstrated in their use as aids in grafting practices in horticulture and, from the forester's point of view, in the rooting of cuttings of forest tree species.

The initial discovery of growth-substances in urine, and their subsequent chemical identification, is described by the author in simple, yet comprehensive language. Following this introductory information, the next chapter naturally develops the subject in a logical manner in a technical treatise on the synthesis of auxins. Nicol follows this with a discussion of physiological methods of testing auxins in a quantitative manner, distinguishes between growth promotion and growth regulation, and illustrates the scientific results of use of growth-substances with concrete examples. The remainder of the book treats of the isolation of growth-substances from natural sources, chemistry in relation to growth, classification and nomenclature of growth-substances, their identification, and in conclusion presents a tabular index of all known growth-substances, and outlines their physical properties and significant tests for individual compounds.

Perhaps one of the most useful components of

the book is the selected bibliography at the end of each chapter. Though research in the fundamental relationships of growth-substances in plants is in its infancy, rapid strides are being made in filling the gaps in our fundamental knowledge concerning the growth of plants. This book helps in bringing together the results of research to date, and in unifying some of our fragmentary conceptions regarding growth substances.

Albert G. Snow, Jr.,
Northeastern Forest Experiment Station.

Statistical Methods Applied to Experiments in Agriculture and Biology. By George W. Snedecor. *xiii+378 pp. Revised. Collegiate Press, Inc., Ames, Iowa. 1938. Pr. $3.75.*

The fact that the ink had hardly dried on Schumacher's review of the first edition of this book before it was sold out attests not only the widespread interest in the subject, but also the excellence of the book.

According to the publisher's notice, the author has added 50 pages, and made available in this edition most of the material in *Correlation and Machine Calculation,* now out of print, and his book *Analysis of Variance and Covariance,* which is practically exhausted.

In the opinion of the writer, this book is one of the most easily understood statistical books in the English language, primarily because of its easy conversational style, the fact that the author does not confuse the reader by omitting steps or by taking unexplained short cuts, and the large number of worked-out problems. Furthermore, it brings together and makes readily available many of the up-to-date small-sampling technics that are buried in original sources and often are difficult to obtain and to comprehend.

In one respect the writer disagrees with Schumacher, who is of the opinion that the book is not suitable for a text book because it is "a veritable storehouse of information. . . . ." In spite of this, however, the writer believes it will make a good text book because of its other admirable qualities.

No matter what the field, this book will be found helpful to anyone who uses small-sampling technic in analyzing and interpreting quantitative data.

R. M. Brown,
University of Minnesota.

The Black Poplars and Their Hybrids Cultivated in Britain. By G. S. Cansdale and members of the staff of the Imperial Forestry Institute. *52 pp. 1 pl. University Press, Oxford. 1838. Pr. 3s./6d.*

In Britain the poplars are among the least utilized of the common timber trees. There is hardly an appreciable quantity available at present, although a market exists for poplar timber which could profitably be grown on a much larger scale. On the best soils members of the black poplar group can be harvested in twenty years, or even sooner if widely spaced. This entails pruning, which is easier if trees such as the hybrid *robusta,* with small ascending branches and an upright habit of growth, are grown. A planting distance of 15 to 30 feet is recommended. It is also recommended that large plants be used for out-planting and that the soil be well mulched or cultivated. Black poplars will make 3 to 6 feet or more of height growth in a year and will put on annual rings from one-half to one inch in width. It is claimed that exceptionally fast diameter growth, however, usually results in timber of inferior quality.

The work reported in this bulletin is in part a result of the need for absolutely certain identification of poplars in connection with research on poplar canker. Characteristics considered of importance in identifying the black poplars include, among others, the translucence and ciliation of the leaf-margin, glands at the junction of petiole and leaf-blade, shape of the petiole and of the branchlets in cross section. A brief historical review of questions of nomenclature is included.

The specific descriptions of the black poplars and their hybrids are given in considerable detail. Illustrations would have aided considerably in the discussion of the various poplars, but the key, which includes not only the black poplars and their hybrids but also poplars of other groups that are planted in Britain, is easily used. A fairly complete bibliography is included.

This publication, and that by Houtzagers reviewed in the March, 1938, Journal, are welcome additions to our knowledge of an important genus. In the reviewer's opinion, however, both authors have overlooked what is probably the chief cause for the confusion in nomenclature. Poplars are usually propagated vegetatively and thus widely disseminated as clones. Such vegetatively propagated individuals, originating from a single tree, maintain the characteristics of the

parent, with the possibility of only rare mutations altering the parental characteristics. How such vegetative propagation can lead to taxonomic confusion has been illustrated by Stout[1] in the case of *P. candicans*. This so-called species exists only as a female and is undoubtedly a variant of the balsam poplar native to the northeastern United States. It is characterized by its heart-shaped leaves, but as Stout has pointed out, this characteristic and others are within the range of variation within the native species. Undoubtedly clonal variants of other American species exist in Europe and have added to the general confusion. Since there is considerable variation among the intraspecific progeny of the northern cottonwood, it is entirely probable that distinct clonal variants of this species are masquerading in Europe under specific names.

Both authors have lumped clones with similar taxonomic characteristics under a single name. For example, under X *P. generosa* on pp. 40-41 of the English bulletin, it is stated that four male seedlings resulted from artificial cross-pollination between *P. angulata* and *P. trichocarpa* in 1912, and that additional crosses in 1914 produced female hybrids identical in other characteristics with the first. "Both sexes are now known simply as *XP. generosa*." This lumping is particularly to be regretted in the case of hybrids since the individual seedlings derived from a cross between two species are not necessarily identical even though they may fit the same taxonomic niche. Schreiner and Stout[2] have preferred to assign individual clonal names such as the Frye poplar, the Maine poplar, etc., to new hybrid seedlings. These names apply to only one seedling of a cross; they are not applied to a group of seedlings with the same parentage. Such names are analogous to those used to designate horticultural clones, such as the Baldwin apple, Van Fleet rose, et cetera.

To illustrate the possibilities for confusion by applying a single name to a group of hybrid seedlings of the same parentage, the reviewer can refer to careful observations on the development of individual seedlings from a cross between *P. balsamifera virginiana* and *P. trichocarpa*. These seedlings have been grown in plantations in western Maine and are now ten years old from the time of out-planting. Wide variation in many characteristics has been observed among the six hundred first-generation seedlings of this parentage. Observed variations in the time of leafing and budding might, on the basis of the classifications given in the bulletins under review, cause considerable difficulty. There is also a great variation in vigor of growth; some of the hybrids are less than 25 feet in height, whereas the most vigorous are well over 50 feet tall and 8 to 9 inches in d.b.h. Most striking, however, is the variability in resistance to *Melampsora* leaf rust. Although no seedlings of this parentage are immune, some are highly resistant, whereas others died as a result of rust injury before they were five years old.

It is thus apparent that names like X *P. serotina* and X *P. generosa* should not be applied to a group of hybrids merely because they resemble each other taxonomically. Among the six hundred seedlings mentioned above, certain rust-resistant and other highly susceptible seedlings are sufficiently similar in outward appearances to permit the use of one name, but such a mixture of clones could not be successfully used either by the experimentalist or by the grower. The confusion in the identification and use of poplars which are propagated vegetatively can be eliminated only by the selection of excellent individual trees, assignment of a clonal name (or number), and strict maintenance of the identity of the clone.

Ernst J. Schreiner,
Northeastern Forest Experiment Station.

[1]Jour. N. Y. Bot. Gard. 30:25-37. 1929.

[2]Bull. Torrey Bot. Club 61:449-460. 1934.

Cutting and Selling Pine Pulpwood. By C. H. Schaeffer. *39 pp. Illus. South Carolina Commission of Forestry. Columbia, S. C., 1938.*

During the past year several bulletins and mimeographed pamphlets have been published on the subject of pine pulpwood in the South. These have presented valuable information on units of measure, cutting practices, buying and selling methods, and handling of pulpwood as an intermediate forest crop.

Cutting and Selling Pine Pulpwood presents information especially applicable to South Carolina. Many of the instructions, volume tables, discussions of units of measure and methods of cruising, and the chapter "Timber Cropping" are, however, equally suitable for use throughout the southern pine region.

The two charts on pages 17 and 34 effectively emphasize the increase in pulpwood volume with increase in diameter. Thus, whereas it takes on the average 22 six-inch trees to make a standard cord, it takes only 10 eight-inch or 6 ten-inch trees to produce the same volume.

Of value primarily to timberland owners in the South who are interested in the harvesting and sale of pulpwood, this bulletin also contains information of interest to practicing foresters.

G. H. Lentz,
U. S. Forest Service.

Feathers and Fur on the Turnpike. By James R. Simmons. *148 pp. Illus. The Christopher Publishing House, Boston, Mass. 1938. $1.75.*

This book covers a much larger field than the title would indicate at first glance.

The author, with considerable industry and patience, has produced a text which provides interesting and valuable information and data pertaining to the mortality of wildlife on the highways. But it does something even more valuable; it provides an index to trends of thinking in the intimately related fields of forest management and wildlife management.

The book is divided into two main parts. Part 1 is a comprehensive and well-documented review of the author's specific studies of highway casualties of wildlife, gathered over a ten-year period. It likewise contains interesting observations of human interest on wildlife habits.

In connection with the studies, a receiving station was established where salvaged specimens could be sent for the collection of scientific data. The book, therefore, should prove valuable, not only to the general reader, but to the scientifically inclined reader as well.

Part 2 should be of particular interest to foresters. In his introduction of this part, the author, who is a forester with a wide field experience, makes the significant statement that "Wildlife conservation is marching down the highway to a long delayed recognition and honor." He includes a worth-while chapter on "Forest Management and Wildlife Management." The correlation of practices affecting timber production and wildlife is discussed, along with the need for foresters and wildlife technicians to give and take.

A condensed résumé of the major silvicultural cutting systems is given, together with their advantages and disadvantages to wildlife.

The book is interesting, as well as informative. It is attractively illustrated.

James N. Morton,
Pennsylvania Game Commission.

To Hold This Soil. By Russell Lord. *U. S. Dept. Agric. Misc. Pub. 321. 123 pp. Illus. Gov't. Printing Office, Washington, D. C. 1938. 45 cents.*

Behold Our Land. By Russell Lord. *310 pp. Illus. Houghton Mifflin Company, Boston. 1938. $3.*

Ordinarily, government bulletins are written by specialists, and then, if necessary, dressed up by professional editors or writers to make them more palatable for human consumption. Being aware that specialists tend "to know and to write too much about too little," resourceful Hugh Bennett decided to break precedent and do one of these publications "in reverse." So he hired a "healthily ignorant writer to look at the land, pump the specialists, talk with the farmers and then write a story objectively, independently, and in the large." The result is a rambling but readable discourse camouflaged as a U.S.D.A. Miscellaneous Publication entitled *To Hold This Soil.*

Author Lord starts out with a chapter on "The Film of Life"—the soil; he follows it by one on "New Lands" in which he gives a bit of background by taking a "camera on the moon," and effectively portraying the happenings on this continent from the day seashells were being elevated to the mountain tops until the present time: all this against a vivid, easily comprehended time scale. He then proceeds to describe the taming of the "first wests" and how they looked two hundred years later, and in successive chapters how the "midlands and high plains were taken," what happened to the "last wests," and how "back of yonder" was exhausted. Behind such intriguing subheadings as "Northward," "Waves on the Plains," and "The Maddened Gila," he artfully introduces a glimpse of the temporal dominions of the Soil Conservation Service and hints at the nature of its work (but does not purport to puff up the profession or glorify the conserva-

tor). Thirty-nine large (almost letter-sized) illustrations add much to the text. They have been chosen well as to detail and each packs a story more potent than words could possibly portray or relate.

Behold Our Land is a jazzed-up cosmopolite cousin of Miscellaneous Publication 321. Different in format and binding, in typography and price, it nevertheless repeats the same story in practically identical words. It has shorter chapters but more of them—thirteen instead of eight,—and only thirty-three illustrations. There are also a few obvious errors such as "walnut, . . . tamarack (larch) . . . and maple were new trees to white settlers" and "Connecticut is roughly thirty-four million acres in extent." But these are perhaps pardonable when one is writing "in the large."

In the book, as in the bulletin, each chapter is prefaced by "jewels of thought" from the pens of Brahmin intellectuals of past and present day. Also in context are numerous utterances of many individuals from different eras,—Vergil to Wallace, Shen-nung to Shaler, Burke to Bennett. It is interesting to note how in the past 5,000 years, in the hey-day of promotion and exploitation, there have always been voices crying out against soil abuse, warning of the menace of soil erosion. Following are but a few examples:

2700 B. C. Sage antecessors of Confucius on forest influences: "To rule the mountains is to rule the river." And "mountains exhausted of forests are washed bare by torrents." (They understood the menace of accelerated erosion, they knew how to handle their land; but they didn't do it. Look at their land today!)

590 B. C. Ezekiel on overgrazing: "Seemeth it a small thing unto you to have eaten up the good pasture, but ye must tread down with your feet the residue?"

30 B. C. Vergil on sheet erosion:

". . . For repeated crops
"Of poppies, sleepy things, or flax or oats
"*Scorch up the plain,* which yet will bear them well
"If regular rotation is observed. . . ."

And on rocks and mudflows:

"Happy old man! Thy farm is still thine own, . . .
Though barren stone and muddy bogrush spread
O'er wasted pastures. . . ."

50 A. D. Pliny on absentee landlordism and share-cropping "The growth of cities and luxury enervates men and causes them to entrust the care of the soil in the hands of ignorant slaves."

1790 A. D. George Washington on over-cutting and destructive tillage: "Our lands . . . were originally very good, but use and misuse have made them quite otherwise. We ruin the lands that are already cleared, and either cut down more wood, if we have it, or emigrate into the Western country."

1936 A. D. Hugh Bennett on the dust storm of May 11, 1934: "That storm swept from the Great Plains three hundred million tons of rich soil. It did another thing. It brought to the consciousness of numerous city people the fact that something was going wrong with our agricultural domain."

The consciousness which Bennett speaks of is still weak and limited; the illusion of permanence still too fixed in many minds, particularly in those who should be leading the way to recognition of the plight of our soils. Lord is hardly exaggerating when he says,

"Scientists in general, and geologists in particular have . . . tended almost without exception to give comfortable support to the same dream of Earth's immobility and patience. . . . Wonder must grow that of so many scholars stirring little heaps of earthly specimens and phenomena, so few have detected what was going on beyond the end of their noses; and saw what it meant . . . (The) facts are written large upon the hills . . . (Yet) they go right on teaching their geology, their botany, their zoology, their chemistry and physics . . . with no thought or mention of the tragic transformation of the good green country, roundabout."

Somehow, widespread consciousness must be aroused and the soil governed. Self-governed, if possible, says the author. Whether Americans are sufficiently energetic, resourceful, intelligent, and tractable to shift from promotion to husbandry; whether we will actually muddle through the mess we created, or whether we will simply muddle along, each generation condemning the succeeding one to a lower standard of life, are questions Lord does not attempt to answer.

In general, foresters may find this all rather repetitious stuff—the theme gone stale, the story grown old. After all, it isn't for naught that they as a group have earned such epithets as "emotional cultists," "toscin ringers," "White Horse Riders" in four decades of preaching conservation of forests and waters, grass and soil. But still there may be something in these two treaties—a word, a phrase, or an idea—which will prick the mind of even the most calloused

veteran conservationist. Like all the yelling to "hold that line!" at the big game, these may not actually stave off defeat or win a victory. But they may help one to get in the mood.

T. E. Maki,
Intermountain Forest and Range Experiment Station.

Forest Research in the United States. By Lake States Forest Experiment Station, in cooperation with Committee on Forestry, Division of Biology and Agriculture, National Research Council. *138 pp. (Mimeographed.) National Research Council, Washington, D. C. 1938.*

Research workers are notoriously critical, not only of what others are doing, but also of their own programs. It is an excellent trait.

The desire to be objective in thinking about one's own work is unfortunately not common among salesmen and propagandists. It is a good thing, therefore, when those of us who are responsible for using science to promote the public welfare occasionally step out of our role as evangelists for our particular programs, and attempt to evaluate our objectives and procedures impersonally, with a minimum of "loyalty" to the agencies and the methods that have brought us where we are.

For the past two years or so a group of 15 foresters, under the chairmanship of Raphael Zon, and with the sponsorship of the National Research Council, has been making a survey of forest research. The 138-page report of this committee has now been issued in limited edition, in mimeograph form.

Using the questionnaire method, they obtained from forest research agencies throughout the nation a list of the projects under way during the period 1933-38. The second half of the report consists of a classified list of these by field of study, geographical region, and agency doing the research.

The committee found 1,308 separate projects being carried forward by 904 research workers, at an annual cost of about $7,000,000. These studies are under way in 105 different organizations, but 61 percent of the funds spent on forest research come from federal sources. Forest schools contribute only 2.3 percent of the money, and endowed and state-supported institutions account for but 0.5 percent. Private agencies supply 35.5 percent.

This estimate of expenditures indicates that forestry is currently receiving research support comparable to that given agriculture. A survey for 1936, made by H. P. Barss, indicated a total of $35,607,000 spent on agricultural research, which is equivalent to 0.37 percent of the gross farm income for that year. The $7,000,000 used in forest research is 0.35 percent of the $2,000,000,000 gross annual value of products turned out by forest industries.

One striking difference between the organization of forest research and that in agriculture is that so little of the money used in finding new forest facts is available to institutions training the men who are to become the technical leaders of forestry in the future. It would seem to the reviewer that the committee might well have emphasized the need of having a larger portion of the research contribution from federal sources made available to educational institutions to be used for the double purpose of research and the training of research workers.

The U. S. Department of Agriculture is annually allotting more than 5½ million dollars to the state agricultural experiment stations. Most of these are associated with agricultural colleges which provide opportunity for graduate students to work part time on research. Experience has amply demonstrated the wisdom of this procedure, for it is common knowledge that a station associated with a strong graduate school usually accomplishes more research with a given expenditure of money than is possible where the research is all done by full-time workers not associated with an educational institution. The most important advantage, of course, is that superior new personnel is being trained at the same time to provide leadership in agricultural teaching and extension, as well as in research.

Without explaining the exact methods that were followed, the committee rated the forest research projects into three grades. It is inferred this rating is based on the committee's opinion regarding such matters as financial support; the use of "standard techniques"; the training and scientific knowledge of the project leader; and the time he can give to the conduct of the experiment. To the reader, the impression is given that the mere title of the project and the amount of financial support available formed a basis for much of the committee's evaluation.

This reviewer never felt that the name of a horse, or what he cost, was any indication of how fast he could run; nor was it wise to put too much reliance on how the horse looked. The only dependable procedure is to put a stop watch on his performance. If one were to measure the effectiveness of the forest research work now under way in the United States, it would seem that no single yardstick would so nearly duplicate the objective methods of scientific appraisal as to summarize and evaluate the publications of forest research workers over a given period of time. Why not find out what the $7,000,000 is actually yielding in the way of new and significant facts? Why not compare, both quantitatively and qualitatively, the published output of forest research workers with that of investigators in similar scientific fields?

Throughout the report there run such phrases as "from a forester's standpoint," "within these fields foresters," and "within the forester's field." Sometimes the reader almost gets the idea the committee was thinking of forest research in terms of employment opportunities for foresters rather than as a division of scientific endeavor which holds large promise of serving the public welfare, and which calls for specialized training in a score of scientific disciplines. Medical research has long suffered under the handicap of the open opposition of medical men to research in the medical field except by those holding a medical degree, forgetting that the M.D. degree is not a badge of competence as a research worker, but rather is a certificate of ability as a professional practitioner. It will be a misfortune if foresters develop a philosophy that foresters have an inside track or special advantage in the technical phases of all research associated with forestry.

The report of the committee, unintentionally, I am sure, supplies proof of my contention. In its evaluation of the quality of forest research now under way, it states, "No other field of forest research is believed to be more adequately covered today than the field of wood technology." Everyone knows that most of the workers in this field are engineers, chemists, physicists, botanists, and other non-foresters. In the next paragraph, the report speaks of "The comparatively low standard of silvicultural projects." It is common knowledge that foresters almost completely monopolize the silvicultural investigations.

The only safe position for anyone to take in a matter of this kind, it is obvious, is to select research personnel on a basis of competence for the jobs to be done, and not on whether they happened to come up through a particular professional school. There are many forest research projects that inevitably demand technical forestry training as a prerequisite. But to infer that foresters as such can be expected to do a better job in all forest research, just because they are foresters, is to put group loyalty ahead of research efficiency.

Particularly in the field of forest economics is there need for critical and objective thinking without the bias of loyalty to forestry as a profession or to the concept that the growing of more trees is inherently a desirable national objective. The committee might not agree with this contention, but on page 53 of its report it documented this need by saying, "The profitableness of public forestry has been taken too much for granted, it being assumed that if public forestry cannot be shown to yield monetary returns it still is desirable because of the social values inherent in public forests."

Certainly one of the most fundamental research problems in forestry is why it is advocated by so many, but practiced by so few. The United States is a capitalistic nation, and almost all productive enterprises are assumed to be carried on by private persons for private gain. Is the growing of trees an exception to this general policy of our national economic organization? Have foresters adopted the defeatist philosophy that nothing can be done to make forestry an enterprise in which private initiative finds an opportunity for profit?

It seems to the reviewer that the committee, in failing even to discuss this problem, missed an important opportunity. Forestry in the United States is not going to have unity of purpose or program until those engaged in the forestry profession definitely decide whether tree growing can be a private enterprise like agriculture, must be a public enterprise like parks, or may well be an effective combination of public and private enterprise.

The whole conservation movement, in commercial forestry, farm woodlots, game, soil erosion control, and in a half dozen other fields, faces this challenge of determining under our capitalistic economy the role of private enterprise in respect to natural resources that are essential to

the public welfare. Would it not be well for foresters, as representatives of one of the largest components of the conservation program, to invite active cooperation from social scientists, particularly those trained in economics, political science, psychology, ethics, and even philosophy? I wish the committee might have pointed out that foresters have never really asked the social scientists to take such a look at forestry in particular and conservation in general.

Finally, your reviewer cannot join with the committee in that part of its conclusions in which it expresses regret "there is no official coordinating body" dealing with all forest research in the United States. Instead of stating "some authoritative body is needed as a unifying force," I would be inclined to thank God that forest research workers in the United States still have freedom to select their own projects and determine their own methods, subject only to the administrative policies in force in their particular agency. I can imagine no more unfortunate development in forest research than to give some "authoritative" body of men the power to "coordinate and unify" forest research objectives, policies or procedures throughout the nation.

NOBLE CLARK,
Wisconsin Agricultural Experiment Station.

Recreational Development in the Southern Highlands Region. By Department of Regional Planning Studies, Tennessee Valley Authority. *61 pp.* (*Mimeographed.*) *July, 1938.*

The planning agency of the T.V.A. has in this publication marshalled facts and suggestions to enable the inhabitants and their federal and state cooperators in an area of 44,400 square miles to make fuller use of the land by developing its latent recreational potentialities. The document is of interest to foresters because this utilization must take place on or in the immediate environs of forest land.

In an easily readable style are presented a general inventory of the region: its history and indigenous culture, its industries, and its existing recreational facilities. The several possible forms of recreational activities are described with their income significance, supported by evidence from more mature, but comparable, recreational regions.

The closing pages offer a general plan to bring about the proper recreational development of the region. It suggests the formation of a planning commission for each sub-area, and calls for the creation of recreational districts and the stimulation by a promotional council of an immediate program of action. It lists as necessary legislation: "Adequate" conservation laws in Kentucky, Georgia, North and South Carolina, effective county zoning, adequate laws for the development and protection of scenic highways and recreational areas, and laws to regulate and control tourist services.

Like many publications issued by planning bodies, this report leans toward the booster spirit in both style and factual presentation. For instance, those sections dealing with climate do not mention relative humidity as a probable summer disadvantage in comparison with more northerly regions, although in another section the richness of the flora is emphasized and attributed to "high rainfall and high humidity." Then, too, text and charts showing that two-thirds of the population of the United States live within 500 miles of the region might lead to the conclusion that the region is the logical playground of most of the nation.

It is open to serious question whether the region's share of recreational expenditures should be $250,000,000, a sum which bears the same ratio to the estimated total recreational expenditure of the entire country as the area of the region does to the recreational area of the country. Recreational income may not be based on a spatial relationship, for there are differences in travel time to the several recreation regions and in natural facilities there available. If the Southern Highland Region is to get such a share of the income, it must do so at the expense of other regions or the national income must be increased materially and/or a larger share of that income must be expended for recreation.

It is the opinion of the reviewer that planning agencies will not obtain the confidence they must have to be fully effective until their studies present all the facts impartially. Nevertheless, this report contains both an excellent statement of the recreational opportunities in this and other forest regions of like character, and a comprehensive and foresighted, yet practical, plan for the development of those opportunities.

PAUL A. HERBERT,
Michigan State College.

CORRESPONDENCE

February 10, 1939.

DEAR MR. CLEPPER:

The recent address of the Chief Forester of the United States at the Columbus Meeting of the Society and the subsequent discussion, particularly the remarks made by Mr. A. G. T. Moore of the Southern Pine Association, have interested a great many Society members, I am sure. The thought which must occur to individual members scattered over the various regions of the country with their varied climates and forest conditions is, "Can Mr. Silcox's views on forest regulation be squared with conditions in my region or has Mr. Moore the right answer?"

Here in Pennsylvania Mr. Moore's contention that the federal government should fulfill its obligations in regard to fire protection first before talking about forest regulation is not particularly applicable. The state fire protection system is efficient and affords quite ample protection on both state and private lands. But on the other hand, is it advisable to introduce a system of federal regulation to control cutting practices on privately owned lands in the state as Mr. Silcox would have it?

There is plenty of evidence that growing stock is being seriously depleted on many privately owned lands in various portions of the state. In the oak type in and near the southern anthracite coal fields, for instance, mine timber operators are having to go further and further afield to find suitable material for their orders. The average trucking haul for timber coming into the collieries of one of the leading anthracite coal companies was recently estimated by the purchasing agent as more than 50 miles. Many timbermen are having to go 75, 100, and more miles for their timber. All this because clear-cutting, often on steep slopes in the chestnut oak type, has removed all possible forest resources from stands near to the mines for years to come.

While the regenerative powers of the hardwood stands of this region insure future timber supplies when protected from fire, it is not desirable for timber to be "skinned off" in various localities with a resultant dearth of supplies for local wood-using industries and leaving no opportunity for enterprising men to establish sawmills or other processing plants in that area. The fact of the matter is that the average small sawmill man has little if any idea of the advisability of saving growing stock. And, with notable exceptions, the woodland owner is all too ready to liquidate his forest capital for a lump sum, often far below the value of the timber. This in spite of all the forest conservation programs, federal and state sponsored for the past few years.

In view of this situation I would propose that the problem be met on two fronts. In the first place, some form of control is necessary. In this region we have no Southern Pine Association or its equivalent to act as a regulatory influence on its membership as well as on many nonmember forest owners, who, no doubt, come under its influence. The small sawmill operator of Pennsylvania has no connection with any such organization. Some form of federal or state regulation should be necessary. For this state, however, and quite possibly for other states in the Middle Atlantic Region and the Northeast, a state law administered through the state forestry department by which district foresters would be authorized to require lumbermen and woodland owners to conserve growing stock in order to maintain adequate timber supplies for a given area, would be most practicable.

In the second place, let the federal government support state efforts through such a measure as the Norris-Doxey Act which will increase the personnel of the forest extension service as well as providing additional funds for farm forestry research. The ignorance of any conception of sustained-yield practice on the part of a large number of woodland owners and lumbermen shows that the present forestry educational program is not yet adequate. This situation involves no criticism of the state extension foresters. It is a physical impossibility for the present personnel to cover sixty-seven counties and

do full justice to the situation. Along with an augmented educational program, there should be a strong research program in farm forestry, centering particularly on processing and marketing problems.

Let the federal government contribute towards education and research and thus aid the state in its forestry program. Let the state administer regulation where needed.

DONALD D. STEVENSON,
Pennsylvania State College.

DEAR DR. SCHMITZ:

When I read Hall's parable for tax reformers in the January issue of the JOURNAL, I was reminded of a specific case. An Indiana farmer built up a good woods over a period of years, and by accumulating a large volume of timber per acre he secured a high increment. This high increment finally had to bring a minimum stumpage price of $11. per thousand to pay the property tax on the woods which had gradually risen to $3.32 per acre per year. The woods is now classified under the Indiana law for the assessment of forest land, and it is still a good woods. Without recourse to such a law, it is conceivable that the owner might have been tempted to liquidate the forest capital which foresters urge land owners to build up in order to secure a high increment.

T. E. SHAW,
Extension Forester, Indiana.

BEGINNING with the 1939-1940 session, Mississippi State College will open a lower division forestry school. It was decided to install this forestry curriculum so that Mississippi students desiring professional training in forestry would be able to complete part of it at their own School of Agriculture.

UNITED STATES FIFTH IN WORLD WOOD EXPORTS MAINTAINS STANDING OF 1937

A PRESS communique of the Comite International du Bois, Brussels, shows that the United States was fifth in the export of wood in all forms, from Europe and North America in 1938.

The total export last year from the countries in these two continents was 40,231,000 cubic meters, or more than 1,420,000,000 cubic feet of wood including lumber, pulpwood, mine timber, logs and hewn, box shooks, poles, ties, and staves. The American share was only 2,895,000 cubic meters.

Canada was the first wood-exporting country with 10,064,000 cubic meters. It was followed, in order of rank, by Finland, Russia, Sweden, and the United States. The sixth ranking country, Poland, had a wood export volume only 2½ percent less than that of the United States, while Czechoslovakia, in seventh place, with its former total forest area of about 11,500,000 acres, had a wood export only 36 percent below that of the United States.

Of the total export of all wood by Europe and North America, the European countries exported 68 percent and Canada 25 percent, while only 7 per cent was sold abroad from the 215,000,000 acres of commercial saw timber stands in this country.